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CONTRIBUTIONS

TO THE

PALÆONTOLOGY OF IOWA;

BEING DESCRIPTIONS OF

NEW SPECIES OF CRINOIDEA AND OTHER FOSSILS.

BY JAMES HALL,

STATE GEOLOGIST AND PALÆONTOLOGIST.

Supplement to Volume I, Part II, of the Geological Report of Iowa.

PUBLISHED BY AUTHORITY OF THE LEGISLATURE OF IOWA.
1859.

ALBANY, Auguſt, 1859.

TO HIS EXCELLENCY RALPH P. LOWE.

SIR:

IN accordance with your directions given in November of last year, I have the honor to submit herewith a supplement to the Geological Report of Iowa, Vol. I, Part 2, containing descriptions of new species of Crinoidea and other fossils, chiefly from the Burlington and Keokuk limestones.

The greater part of these descriptions are of Crinoideæ, and are accompanied by diagrams, without which the relations and proportions of parts cannot be well understood. Completed drawings of many species have already been made, so that less delay will be experienced on this account when the printing of the second volume shall be authorised.

The CRINOIDEÆ embraced in this paper, the descriptions of which are already completed at this date, are above sixty species.

I have the honor to be,
Very respectfully,
Your obedient servant,

JAMES HALL.

NOTE.

THE descriptions of the following species of Crinoideæ were, with a few exceptions, completed in July 1859, and it was my intention to print and publish the supplement immediately. A part of it was thus printed and forwarded to Governor LOWE soon after the date of the address, but the publication has been postponed by circumstances beyond my control.

I have been still farther indebted to Mr. WORTHEN for the use of his collection of Crinoideæ, already acknowledged in the volume, and many of the descriptions have been drawn from his specimens alone; while in others I have been able to avail myself of the extensive collection of Mr. C. A. WHITE of Burlington, which contains numerous new forms of this family of fossils, and affords valuable means of comparison. The greater number of species are from the Burlington limestone of Iowa, a locality frequently cited in the report already published. A few species have been added to those before known in the Keokuk limestone, from specimens recently sent to me through the kindness of Dr. G. M. KELLOGG of Keokuk. The descriptions of the species from the Warsaw limestone, with one exception, were printed one year since (in 1858) in another form, but had not been given to the public, and are first published in this supplement. The diagrams have been drawn with great care by Mr. R. P. WHITFIELD, and I have likewise been indebted to him for very essential aid in preparing the descriptions. J. H.

NEW SPECIES OF CRINOIDEA.

Actinocrinus liratus (n. s.).

Body broadly turbinate below, spreading in a wide thickened rim at the bases of the arms; summit nearly flat at the margin, rising in a low dome towards the centre, and surmounted by a proboscis : base truncate, somewhat deeply excavated for the reception of the column. Basal plates about half as long as the first radials : first radial plates about as high as wide; second radials much smaller than the first, hexagonal, with third radials nearly of the same size and form except narrower, being truncate at the top, supporting a first and second inter-supraradial plate in the same line, and on each side of their upper sloping edges a single supraradial bifurcating plate, which sustains upon its outer side a series of four brachial plates, and upon its inner side a series of supraradial plates, each of which supports brachials on one side and supraradials on the other, giving off the arms on opposite sides alternately, making six or seven arms to each principal division of the ray.

First interradial plate large, hexagonal : second and third ranges of two plates each, sucessively smaller, hexagonal, and supporting two subpentagonal plates in the fourth range, the last ones supporting the outer edges of the plates of the first supraradial series of the adjacent rays.

Surface of plates marked by ridges rectangular to the margins, and coalescing towards the centre; those from the lower side, on the first radials, joining in an arching ridge.

This species is of the type of those with wide-spreading summits and numerous arms. It differs conspicuously from any other of the type at present known to me, in the surface markings, by which it may be readily distinguished.

Geological position and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus glyptus (n. s.).

Body urnshaped below, short, flattened above, with a broad expanded rim which commences at the top of the third radial plate, and extends to the arm-bases nearly at right angles to the axis of the body. Basal plates short, slightly thickened at their lower margins : first radials large, wider than high ; second radials large, hexagonal, width equal to or greater than the height ; third radials smaller than the second, octagonal, wider than high, supporting large supra-radial plates on the upper sloping angles, and truncate above by the first of a group of small inter-supraradials.

The supraradials which rest upon the third radial are the first of a series of four plates (present in the specimen), each giving origin to an arm, the first on the inside, the next on the outside alternately. The number of arms in this species has probably not exceeded ten to each ray = fifty in all. The first brachial series of each division of the ray (in their order of bifurcation) consists of four plates, the second series of two, the third of two, and the numbers in the remaining series are not fully determined.

First interradial plate hexagonal, as large as the second radials, and supporting two small plates, one hexagonal and one pentagonal, with two still smaller plates in the third series and from two to five small irregular plates above, and sometimes a large interbrachial plate between the brachial series of the two adjacent rays.

Anal plate hexagonal, smaller than the first radials : two hexagonal plates in the second range, three in the third, and three small plates forming an arch over the middle one of these, completing the series.

Surface of plates elevated into large high transverse nodes or ridges, which are connected with those of the adjoining plates by short subangular ridges, while the principal nodes exhibit a transverse ridge. The lower surface of the expanded rim is traversed by zigzag subnodose ridges, which follow the ramifications of the ray, and are highest at the centre of each plate, while between the ridges the surface is deeply indented.

Dome composed of a great number of very small, slightly nodose, polygonal plates, with a subcentral depression.

This species differs from others of the same type, by its short broad calyx, its heavily nodose plates, and the less number of arms to each ray; also the margin of the projecting rim has been less deeply sinuate than in most of the species of this type.

Geological position and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus subumbrosus (n. s.).

BODY symmetrically urnshaped, spreading horizontally above in an expanded rim which forms the united bases of the arms : summit depressed convex, composed of small polygonal plates, and terminating in a strong proboscis situated nearer to the anal side; base excavated for the reception of a large column. Basal plates high, sloping gradually to their superior margins : first radials large, higher than wide; second radials hexagonal or pentagonal, higher than wide; third radials smaller than the second, height and width nearly equal, hexagonal or heptagonal, sustaining on their upper oblique edges supraradial plates in double series, having one inter-supraradial plate between the upper, and resting on the edges of the lower supraradial plate. A series of three brachial plates is sustained on the outer edges of the supraradials, and above these commence the arm-plates proper.

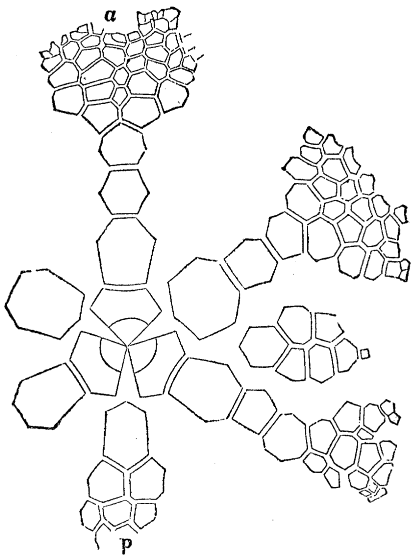
The second supraradial plates of each division of the ray support upon their inner edges brachial plates, and upon their outer edges supraradials of the second order, which again support brachial plates on their outer edges and supraradials of the third order on their inner edges, and so on, giving arms on each side alternately. One ray of the specimen examined has nine, and another twelve arm-openings; the plate of the central branch being still a bifurcating plate.

The interradial series consist of seven plates each; the first hexagonal, supporting two smaller plates in the second series, two in the third, a plate resting between the last two, and a very small intercalated plate above.

Anal plates nine or ten; first one large, hexagonal, higher than wide, supporting two smaller hexagonal plates and three in the third series, with the remaining small plates irregularly placed.

SURFACE of plates slightly convex, and granulose without any appearance of striæ or ridges.

The condition of the specimen does not admit of a satisfactory determination of the full number of divisions in the rays; nor is it easy to determine whether the number of arms are equal from each.



ACTINOCRINUS SUBUMBROSUS.

Geological position and locality. In the Burlington limestone: Burlington, Iowa.

Actinocrinus ægilops (n. s.).

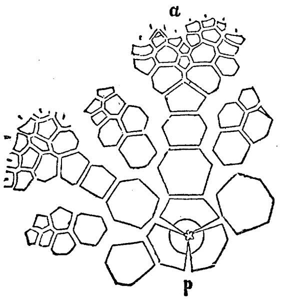
Body urnshaped below, spreading, high, domeshaped above, composed of polygonal nodose plates, and terminating in a strong subcentral proboscis : base slightly excavated.

Basal plates large, thick, projecting below the point of attachment for the column in a bipartite node. First radial plates slightly wider than high, narrower at base than above. Second radials pentagonal or hexagonal. Third radials pentagonal, as large as the second, and supporting on their upper oblique sides large heptagonal supraradial plates : these support, upon their outer oblique sides, brachial plates in double series, and upon their inner sides they sustain supraradial plates of the second order ; these again sustain brachials and supraradials of the third order, in reversed positions : the last supraradials support two brachial plates, giving eight arms to each ray, or forty arms to the whole brachial series. Resting upon the first supraradials and lying between the second, are two pentagonal inter-supraradial plates, the first three times the size of the second.

First interradial plate hexagonal, sustaining on its upper sides two smaller plates, hexagonal and heptagonal, with from two to four small plates above.

First anal plate as large as the first radials, heptagonal, supporting three smaller plates : the remaining anal plates have not been determined.

Surface traversed by low ridges, which pass from plate to plate, meeting in a transverse lanceolate node on the centre of each plate, except the first radials, which are marked by irregular confluent nodes.



Actinocrinus ægilops.

Geological position and locality. In the Burlington limestone : Quincy, Illinois.

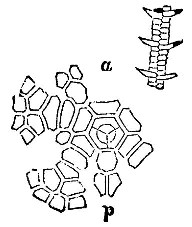
Actinocrinus spinobrachiatus (n. s.).

Calyx very low, nearly flat to the bases of the arms : (summit concealed by the arms and adhering stone.) Basal plates very small, their centres elevated, forming a low rim bordering the articulate facet of the column. First radial plates twice as wide as high, narrow below, the superior lateral sides very short. Second radials short, hexagonal. Third radials short and wide, hexagonal, their lateral sides minute ; sustaining upon their upper edges supraradial plates, pentagonal and hexagonal in form, higher than the third radials and not so wide : these sustain each two brachial plates, giving four arms to each ray [as far as has been ascertained].

First interradial plate octagonal, supporting two smaller interbrachial plates.

First anal plate octagonal, two-thirds as large as the first radials, sustaining two smaller plates. Arms probably sixteen, simple from their origin, composed of a double series of short plates, obtusely wedgeform at their interlocking edges ; every fifth or sixth plate, on either side of each arm, bearing an acute spine nearly a line in length, and projecting laterally from the arm.

Surface of the first radial plates marked by a crescentform ridge, rising near the superior lateral angles, and reaching almost to the inferior margin. Surface of the second radials marked by a transverse ridge across their whole width. The remaining plates of the body are roughly granulose : the plates of the arms are more finely granulate.



Actinocrinus spinobrachiatus.

This species is distinguished by its flat base, which is depressed below the projecting lower margin of the first radial plates; the very short radials, and the elongate arms with lateral spines.

Geological position and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus perumbrosus (n. s.).

Body elongate urnshaped, depressed convex above, spreading at the arms into a broad thin flange-like expansion, formed beneath of the base-plates of the arms, and above of the plates of the summit : this expansion is traversed by the cavities of the arms, opening into the cavity of the body in one large passage from each ray, bifurcating as the arms are given off from each side; base excavated for the attachment of the column. Basal plates large, high. First radials very long; superior lateral angles large. Second radials regularly hexagonal, less than half the size of the first. Third radials octagonal, supporting on their upper oblique sides supraradials, and on the upper horizontal side the first of a series of six inter-supraradial plates : the supraradials sustain on their outer edges a series of several large brachial plates, and on their inner edges supraradials of the second order : these again sustain other similar plates, but reversed in position alternately, until six arms are given off on each side of the ray. Several small interbrachial plates exist between the divisions of the ray and the several brachial series. First interradial plate regularly hexagonal, sustaining two smaller plates, one pentagonal, the other hexagonal : in the third series are two hexagonal plates, in the fourth, two, and a smaller plate above, making eight in all.

First anal plate hexagonal, with two in the second series, four in the third, four in the fourth, and two or three smaller plates above.

Surface traversed by ridges running from the centre of each plate, and uniting with those of the adjoining plates : the union of these ridges forms nodes on the middle of the interradial and anal plates, while on the radial series they form a transverse ridge crossing the centre of the plate. Also the first radial plates have several other ridges, which, commencing below the transverse one, pass down and unite with those of the basal plates. Above the third radial plate the centres of the different ranges of the plates are elevated into ridges, leaving zigzag channels between.

The summit is composed of a great number of small polygonal nodose plates, and is apparently destitute of a central proboscis.

This species differs from others of the type, in the form of the body, surface markings, and relative proportion of the plates.

For a diagram of this species, see end of Supplement.

Geological position and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus regalis (n. s.).

Body elongated, subturbinate below ; the base very small, expanding gradually above to the first supraradial plate, where it spreads out broadly and almost rectangularly to the axis of the fossil.

Basal plates high, about two-thirds the height of the first radials. First radial plates long, longer than in the other species of this type. Second radials about as long as wide, hexagonal. Third radials heptagonal, about as large as the second radials, and supporting two radials of the second order : each of the latter, on the outer sloping side, supports a series of brachial plates of five or six or more, to the base of the free arm ; the summit of each one supports a radial plate of the third order, while the inner sloping edges support an inter-supraradial plate which is succeeded by a second one. The second supraradial supports a third supraradial with a series of brachial plates on the inner sloping face, and thus alternately to the fifth supraradial plate. This arrangement is somewhat varied in the anterior ray, and we have eight arms to each division, or sixteen to the entire ray ; while the others have seven to each division, giving fourteen to each ray, and making the arm-formula

$$\begin{array}{c} 16 \\ \hline 14\quad 14 \\ \hline 14\quad 14 \end{array} = 72.$$

First interradial plate as large as the second radial, and supporting a second range of two smaller plates, which are succeeded by a third, fourth and fifth range of two plates; the sixth range of two plates a little inclined, and a seventh and eighth range of single plates.

First anal plate as large as the first radial, hexagonal, supporting two plates each a little longer than the second radial, and successively a third, fourth and fifth range of smaller plates, the last three arching over the central one of the range below; the last range of three being succeeded by three or four plates, in somewhat irregular order, one above the other.

The suture-lines of the plates are moderately impressed, and the surfaces marked by sharp ridges, which, meeting at the junction of the plates, extend towards the centre, and, in the lower plates, unite at various angles according to the form of the plates; the junction of the ridges marked by sharp nodes, and sharp transverse ridges marking the centres of the radial and lower interradial plates.

Summit very broad, nearly flat or scarcely concave in the centre, gently sloping downwards towards the margins, without proboscis, composed of a great number of small polygonal plates which are slightly nodose.

Column round, composed near the body of thin plates: canal large, pentalobate.

This species is similar in structure to all the others of this group, but it differs essentially in the proportion of its parts. The base is narrow, and the basal plates high or long; while in the others they are comparatively very short, except in *A. perumbrosus*. The manner of bifurcation of the arms is somewhat different; the ranges of plates, being more attenuate, giving room for a greater number of arms. In the other species of this group, the ranges of plates which are properly brachials, become, in the anterior ray of this species, supraradials, and, after branching from the main division of the lateral portion of the ray, give origin to three arms each; which, with the five others, make eight arms to each division, or sixteen arms to this ray. In one of the antero-lateral rays, seven arms can be counted to each division, and the postero-lateral rays appear to be subdivided in the same manner. In the surface markings, the ridges, as described, pertain more particularly to the basal, radial, and first anal plates : in the interradial and upper anal plates, the ridges, except the central one of each face, are interrupted and reduced to nodes; so that the pattern of each plate of these series, taken separately, is a five-, six- or seven-rayed star having a node placed in the angle between each pair of adjacent rays. The ridges on the underside of the expanded rim differ from most of the others in being less angular, and the spaces between not so deeply excavated. There are also a greater number of small intercalated plates between the brachial series, than in others of the type.

For a diagram of this species, see end of Supplement.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.

The preceding species (of this paper) are all of a peculiar type, the most striking feature of which is the wide-spreading dome, which is usually depressed or nearly flat upon the top; the margins widely expanded, often extending beyond the limits of the body (from half to three-fourths of an inch) for a distance half as great as the diameter of the body, and sometimes having in the entire diameter an extent of four inches. This flattened dome, when perfect, has the form of a ten-rayed star, or a disc with ten angles, two of the angles proceeding from the divisions of a single ray. These angles are sometimes obtuse and sometimes acute, or extended into prominent points.

Some of the forms of this type have four and even five plates in the direct line of the radial series; though the supraradials always diverge from the upper sloping sides of the third radial plates, and those in direct line above the latter are inter-supraradial plates. Some of the species are furnished with a central or subcentral proboscis; while others have a simple aperture in the crown, marked by a slight depression; and others appear to be destitute of any opening whatever, so far as we can determine. The flattened expansions of the margins are composed of the plates of the summit above and the plates forming the continuation of the rays, the inter-supraradials and brachial plates below, these forming the two walls. The space between these walls is traversed by the soft parts of the animal, ramifying in numerous divisions and proceeding to the bases of the arms. When the space is exposed by the removal of the plates of the dome, or of those of the lower side, the wide central cavity of the upper part of the body is laid open, and from this all the subdivisions may be traced to the bases of the arms. Each division of the ray is separated from the adjacent one by a vertical wall of plates, filling the space between those of the dome and the wall below; and in this way we are able to trace the channels made by the subdivisions of the fleshy part of the ray to the bases of the external arms, the number and extent of the ramifications corresponding to the number of arms on the external margin.

The entire border of the disc is surrounded by the arms rising in pairs, vertically from the periphery. The arms are short, simple from their origin, and composed of a double series of interlocking plates.

Actinocrinus divaricatus (n. s.).

Body short, broadly turbinate below, abruptly spreading from the base of the second radial. Basal plates short, abruptly spreading, and the lower exterior margins extending almost at right angles to the axis of the fossil, being broadly sinuate at the sutures; forming, when seen from below, a broad trilobate disc : upper margins of plates scarcely rising above the upper plane of the disc.

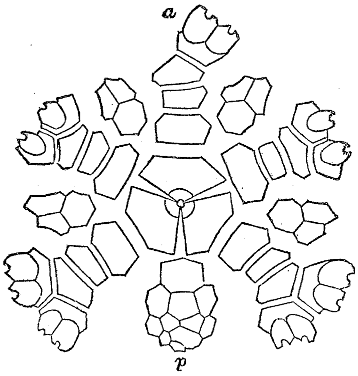
First radials short and wide; lower margins of those resting over the suture, scarcely curved : upper margins concave. Second radials short, about twice as wide as high; one of them quadrangular; the others truncated on one of the upper lateral angles, giving a fifth short side. Third radials short, supporting on the anterior and postero-lateral rays a single supraradial plate on each of the upper sloping sides; these each sustaining a pair of arms, while in the antero-lateral rays the only division is upon the third radial. The arm-formula is

$$\frac{4}{\dfrac{2\quad 2}{4\quad 4}} \text{ as in } \textit{Actinocrinus quinquelobus.}$$

First interradial plate large, subheptagonal, about twice as wide as long, and supporting two more elongate unequal second interradials. First anal plate as wide as high, differing much in proportion from the first radial plates, and supporting a second range of three plates, and above this an irregular range of four plates, with three unequal plates in the fifth range.

Dome moderately convex, with a central spine, and a single strong spine placed at the summit of each ray above the arm-openings.

This species corresponds to *A. quinquelobus* in its arm-formula, but differs very conspicuously in the form of the body below the arms, the expansion of the base, and the proportions of the plates. The arms of this species spread more abruptly, being at their bases nearly at right angles to the axis of the fossil: the spines are broad at the base, contracting above, and thence tapering more gradually; their entire length unknown. The dome is crushed, so that its original form is not known, but it does not appear to have been as much elevated as in *A. quinquelobus*.



ACTINOCRINUS DIVARICATUS.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.

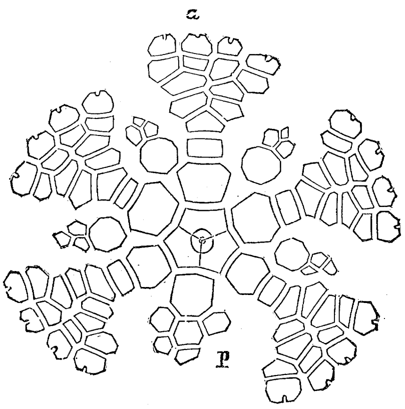
Actinocrinus clypeatus (n. s.).

BODY broadly turbinate and abruptly contracted below the arms. Dome broadly rounded, depressed-convex above, and terminating in a medium-sized central proboscis. Basal plates low, rounded, and curving gently inwards to the central depression for the insertion of the column. First radial plates proportionally large, wider than high. Second radials small, twice as wide as high. Third radials small, pentagonal on the anterior and antero-lateral rays, and hexagonal on the postero-lateral rays, supporting on their upper sloping edges supraradials in double series; the upper one of these also bearing on its upper edges two brachial plates, which are likewise in double series, giving four arms from each ray; making altogether

$$\frac{\frac{4}{4\quad 4}}{4\quad 4} = 20 \text{ arms.}$$

Interradial plates four in each series; the first one large, nine- or ten-sided, supporting on its upper edge two irregularly formed plates, with a still smaller one above. Anal series composed of six plates; one large, heptagonal, supporting three smaller polygonal plates, the central one of these again supporting two small plates above.

Surface of the plates on the entire body slightly convex; those of the dome more convex than those of the body below: minute surface-structure finely granulose.



Actinocrinus clypeatus.

In the general form of the body, this crinoid bears considerable resemblance to *A. æqualis* (Iowa Geol. Report, Vol. i, Part ii, pl. 11, f. 4), but differs materially in the number of arms, and also in the surface of the plates; those of that species being distinctly nodose, while these are but slightly convex.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.

Actinocrinus decornis (n. s.).

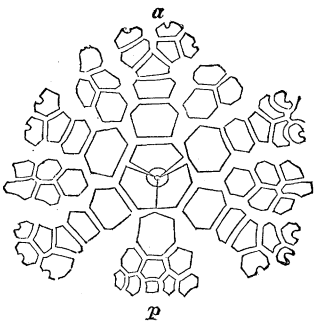
Body turbinate below the arms, and having the arm-bases separated into lobes by depressions at the interbrachial spaces: base truncated. Basal plates short, slightly protruding, forming a rim around the base of the specimen. First radials large, hexagonal and heptagonal, little wider than high. Second radials hexagonal, twice as wide as high. Third radials smaller than the second, width double the height, pentagonal, spreading; sustaining on the upper sloping edges, in the anterior and postero-lateral rays, a double series of brachial plates on one side, and a supraradial plate on the other; which supraradial supports a single brachial plate on each of the inclined edges, and, on each of the antero-lateral rays, they support on each side a double series of brachial plates only, making the brachial formula

$$\frac{\dfrac{3}{2\quad 2}}{3\quad 3} = 13 \text{ arms in the entire individual.}$$

First interradial plate comparatively large, hexagonal; sustaining two in the second range and two or three in the third, which are more properly interbrachials. First anal plate heptagonal, a little higher than the first radials; sustaining three smaller plates in the second range and five in the third, with other plates above filling up the anal area, the number and arrangement not determined.

Dome composed of slightly protuberant, medium-sized, polygonal plates, and ornamented by five lateral and a central node, or partially developed spines, which, in the specimen, are concave at top.

This species differs from *A. cornigerus*, described in the Iowa Report, and from all its congeners, in the proportions of the plates, as well as in their form, and also in the number and arrangement of arms; which differences may readily be seen by a comparison of the different diagrams given. If the partial development of the spines should prove a constant feature, it will be a good specific character, although the other differences given are sufficient to distinguish it from any other of this type.



ACTINOCRINUS DECORNIS.

The calyx expands more rapidly than in *A. cornigerus;* the sides are more deeply sinuate, and the arm-bases larger.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.

Actinocrinus quinquelobus (n. s.).

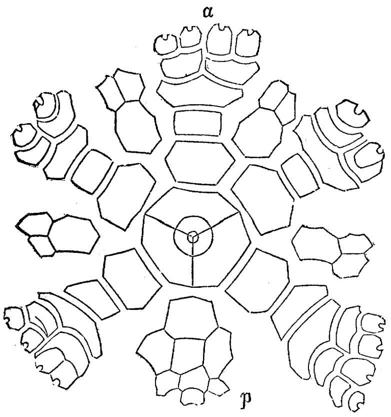
Body urnshaped below, broadly truncate at the base, and deeply sinuate on the interbrachial spaces. When deprived of its appendages, the body presents a strongly pentalobate character, and is of a pyriform shape with an inflated dome.

Basal plates large, projected in a thickened rim around the base of the cup, and overhanging the top of the column. First radial plates having the appearance of being hexagonal, from the straightness of their lower margins; width once and a half that of the height. Second radials quadrangular, except in one of the postero-lateral rays, where it is pentangular (probably accidental), nearly twice as wide as high. Third radials short but very wide, of irregular form, with from seven to nine angles; sustaining on their upper edges two supraradials with brachials above, except in the antero-lateral rays, where they support brachials only; giving to each of these rays two arms, and to each of the others four; making the brachial formula

$$\begin{array}{c} 4 \\ \hline 2 \quad 2 \\ \hline 4 \quad 4 \end{array} = 16 \text{ arms.}$$

First interradial plate large, octagonal; sustaining two smaller plates in the second range, which are situated high up between the brachial plates. First anal plate heptagonal, smaller than the first radial plates, with three smaller irregular formed plates in the second range and a like number in the third, with several smaller plates above extending up to the aperture, which is small, slightly protruding, and situated high on the dome of the crinoid.

Dome elevated, inflated, nearly equaling in height the cup of the specimen, composed of medium-sized, polygonal, convex plates, and ornamented by five lateral and one central spine, which, in the specimen, have been broken away: the lateral spines are situated one above the centre of each ray. The interbrachial and anal spaces are deeply depressed, dividing the body of the crinoid into five lobes, each of which sustains one of the sets of arms.



Actinocrinus quinquelobus.

This species differs from *A. cornigerus*, figured in the Iowa Report, in the greater height of the calyx, in the different proportions and height of the plates, and also in the number of the arms, the bases of which are much larger and more prominent, while the dome is higher and more ventricose.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.

Actinocrinus glans (n. s.).

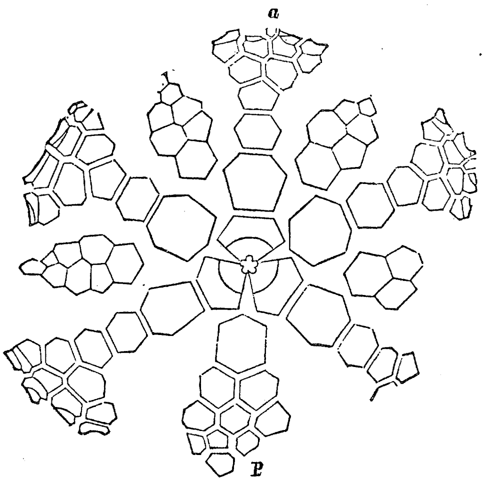
Body symmetrically urnshaped below, regularly convex above, and terminated in a medium-sized central proboscis. Basal plates large, massive, convex in the centre, and having a large concave cicatrix for the articulation of the column.

First radial plates large, about as high as wide, hexagonal and heptagonal. Second radials distinctly hexagonal. Third radials as large as the second, pentagonal and hexagonal, and supporting on each of their upper sloping edges a supraradial of large size, which in turn support on each side brachials in double series; completing the rim of the cup, and giving four arms to each ray :

$$\frac{4}{\frac{4\quad 4}{4\quad 4}} = \text{20 arms opening upwards.}$$

First interradials regularly hexagonal, each supporting on its upper edge two smaller plates varying in form from five to seven-sided; these are again surmounted by two still smaller plates in the third series and one in the fourth, making in all six plates in each group. First anal plate large, hexagonal; supporting two smaller hexagonal plates in the second, three in the third series, with several smaller polygonal plates above.

Surface of plates regularly convex. Column large, central; perforation pentalobate.



Actinocrinus glans.

This species, although greatly resembling *Actinocrinus longirostris* (Geol. Report of Iowa, pl. 11, f. 2), is nevertheless a very distinct species, having a greater number of arms, plates of different form, and differently arranged. The arm-openings in this species are directed upwards, while in *A. longirostris* they are lateral : the body is also of a more elongated form. It is very distinct from the *A. urna* of Troost.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.

Actinocrinus calyculoides (n. s.).

Body small, depressed turbinate below the arms, irregularly inflated above : when viewed from the base upwards, it is subelliptical, the greatest diameter of the ellipse being on a line drawn through the body between the antero-lateral and postero-lateral rays. Base truncate.

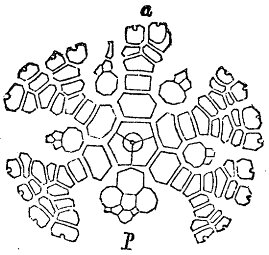
Basal plates low and forming a sharp rim around the column, which is rather deeply set in a symmetrical depression in the centre; notched at the suture-lines, and slightly spreading at the lower edges.

First radial plates comparatively large, wider than high, hexagonal and heptagonal, with the upper edges concave. Second radials quadrangular, wide and short; upper and lower edges convex. Third radials small, pentagonal; supporting on their upper sloping edges, in the anterior ray, the brachial plates in double series, giving origin to but two arms; while in the other rays they support supraradials in double series, the upper ones in turn supporting each two brachial plates also in double series, making four arms from each of these rays:

$$\begin{array}{c} 2 \\ \hline 4\quad 4 \\ \hline 4\quad 4 \end{array} = 18 \text{ arms.}$$

Interradial plates three; one large, ten-sided, supporting two small ones. Anal plates seven; the first one heptagonal, supporting on its upper edges three smaller plates: the central one of these again supports three still smaller plates, completing the series. Proboscis subcentral, large, projecting over the anal side. Surface of body smooth.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.



ACTINOCRINUS CALYCULOIDES.

Actinocrinus planobasilis (n. s.).

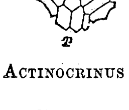
Body flat below, depressed-conical above; having the arms at their origin thrown out in a horizontal direction, and the arm-openings directed downwards. Basal plates small, slightly depressed in the centre for the insertion of the column, not protruding at their margins.

First radials hexagonal and heptagonal, twice as wide as high. Second radials very short, their width and height as three to one, hexagonal. Third radials short and wide, hexagonal; supporting on their upper sloping edges, in the postero-lateral rays, supraradials, probably in single series, with brachials above, giving four arms from each of these rays. Those of the remaining rays cannot be determined from the specimen, the upper plates being absent.

The interradial series consist of one large hexagonal plate below, supporting two smaller plates above, the upper portions of these forming a part of the dome of the specimen. First anal plate smaller than the first radials, hexagonal; supporting two large elongated hexagonal plates above, which extend upwards between the arms of the adjacent rays, and are succeeded by other plates, giving this side a more vertical direction.

The dome forms the bulk of the specimen, and is composed of polygonal plates surmounted by a subcentral spine, which, in the specimen, is removed.

Surface of plates plane or slightly convex.



Actinocrinus planobasilis.

From the form of the summit, there appears to have been a central spine, and at the base of it, on the anal side, an aperture opening upwards, the surrounding plates of which, in the specimen, are broken away, leaving this aperture confluent with the central one made by the removal of the spine.

Geological position and locality. In the Burlington limestone at Burlington, Iowa.

Actinocrinus inflatus (n. s.).

Body flattened, or very moderately convex below. Dome high and inflated, terminating in a large subcentral proboscis, which is composed at base of large spinose plates : proboscis nearest the anal side.

Basal plates of medium size, hexagonal, without reentering angles at the suture lines : base very slightly concave, and margins of plates not produced.

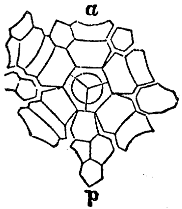
First radial plates large, once and a half as wide as high, straight below. Second radials short and wide, hexagonal. Third radials smaller than the second, hexagonal, twice as wide as high, sustaining on their upper oblique edges brachial plates on the only arm where they remain ; the number of arms undeterminable, on account of the imperfection of the specimen.

In the interradial series there is but one hexagonal plate in each division, which can properly be called an interradial plate, the two plates above being more properly interbrachials. The anal series consists of one hexagonal plate below, smaller than the first radials, and two in the second range ; above these, the number and arrangement cannot be determined. The interbrachial spaces are much depressed, forming deep grooves in the body ; the constriction extending to the upper angles of the first radial plates, giving a peculiar stellate form to the crinoid when viewed from the base.

The plates of the body of the crinoids of this type are very thin and fragile, and the specimens consequently much distorted and broken.

This species differs from *A. planobasilis*, in having a more convex calyx, in the dome being much higher and more inflated, as well as in the proportional size of the plates.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.



Actinocrinus inflatus.

Actinocrinus sexarmatus (n. s.).

Body biturbinate, truncate at base, and surmounted by a rather small subcentral proboscis : base excavated for the reception of the column.

Basal plates short, projecting in a thickened rim around the base of the calyx.

First radial plates rather large, nearly twice as wide as high. Second radial plates proportionally large, pentagonal and hexagonal. Third radials smaller than the second radials, pentagonal and hexagonal, and supporting on their upper sloping edges supraradials of large size; these again supporting on their inner edges the second series of supraradials, while on their outer edges they support brachials : the upper supraradials again support each two brachial plates, and are separated by a small inter-supraradial plate which rests upon the lower and between the upper supraradial plates. This arrangement gives to each ray six arms, thus :

$$\begin{array}{c} 6 \\ \hline 6\quad 6 \\ \hline 6\quad 6 \end{array} = 30 \text{ arms.}$$

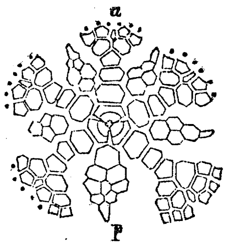
First interradial plate hexagonal, supporting two smaller hexagonal or pentagonal plates; these again supporting another plate of irregular form on their inner angles, with a fifth plate of an elongated form passing up into the interbrachial spaces.

First anal plate hexagonal, about as large as the first radials; upon which rest two smaller hexagonal plates in the second range, three in the third, and two in the fourth, with one elongated plate passing up between the arms of the adjacent rays.

The surface of the plates is traversed by broad ridges flattened at top, which give it the appearance of having been worn down; but its beautifully granulated texture proves this to be the natural condition.

The specimen described, which appears to retain its natural form, has the entire anterior side more prominent, and the plates of the ray at the base of the arms standing out distinctly beyond the curvature of the other parts. The plates on the anterior part of the dome are likewise more protuberant than the others.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.



Actinocrinus sexarmatus.

Actinocrinus quaternarius (n. s.).

Body biturbinate, small, rather higher than wide, greatest diameter central, ridged below and spinose above. Base concave for the reception of the column.

Basal plates very short, and projecting in a scarcely thickened rim below the attachment of the column; divided by a broad and deep notch at the line of junction.

First radials proportionally large, wider than high. Second radials small, short, pentagonal and hexagonal. Third radials small, pentagonal and hexagonal, supporting upon their upper sloping edges supraradials in single series; upon these rest the brachial plates, apparently one only to each arm. This arrangement gives to each ray four arms:

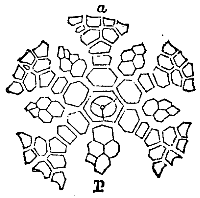
$$\frac{4}{\frac{4\quad 4}{4\quad 4}} = 20 \text{ in all.}$$

The interradials are four in number, except a small intercalated plate in one series; the first one largest, hexagonal or heptagonal, supporting two smaller ones side by side, with a small one between them above, which allows the brachial plates of the adjacent rays to rest against each other. Anal plates five; the first large, hexagonal, as high as wide, supporting two smaller in the second and two in the third series.

The plates of the calyx are all traversed by sharp ridges, those which pass along the ray being the most conspicuous:

these ridges meet on the plates, and form angular nodes or transverse ridges. The plates of the summit are produced into short obtuse spines : proboscis central, large.

This species bears considerable resemblance to *A. multibrachiatus* (Geol. Rep. of Iowa, pl. 11, f. 10), but is more nearly allied to fig. 13 of the same plate, and differs from the first in the number of arms, and from the last in the form of the body and surface markings; the plates of the calyx being more strongly and deeply ridged and the plates of the summit more distinctly spinose, while the body is proportionally broader, and the parts above and below the arms more nearly equal.



ACTINOCRINUS QUATERNARIUS.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.

Actinocrinus gemmiformis (n. s.).

Body small, somewhat biturbinate, the dome being more rotund than the calyx; plates strongly nodose below and spinose above : summit composed of comparatively large polygonal plates, and terminating in a slender central proboscis, the plates of which are sharply spinose. Base concave for the reception of the column, which is of medium size.

Basal plates large, produced into long thin spreading extensions which overhang the articulating facet of the column, giving a tripetaloid appearance.

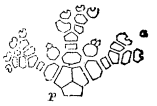
First radial plates large, wider than high, and having the superior lateral angles large. Second radials very small, quadrangular. Third radials larger than the second, pentangular, and sustaining on their upper sloping edges, in the anterior ray, brachials in double series; in the antero-lateral rays, brachial plates on the lateral side and supraradials in double series on the anterior portion of the ray, the upper one of these supporting two brachials : on the posterior lateral ray, they support supraradials in double series on each side, with brachials above, giving two arms to the anterior ray, three to each antero-lateral, and four to each postero-lateral ray :

$$\frac{\frac{2}{3\quad 3}}{4\quad 4} = 16.$$

Interradials three in the anterior series; one large, ten-sided, supporting two small pentagonal plates above. The lateral series consists of one large nine-sided plate below, and a small irregular-formed plate above. Anal series not determined.

Surface of plates produced into elongated nodes; those of the basal first radials and first interradials, and probably anals, most conspicuous.

Geological position and locality. In the Burlington limestone, Burlington, Iowa.



Actinocrinus gemmiformis.

Actinocrinus inornatus (n. s.).

Body depressed turbinate, widely spreading at the arm-bases and abruptly contracted below the basal portion, protruding so as to leave a concavity below a line drawn from the arm-bases to the edge of the basal plates. Dome depressed convex, with a small subcentral proboscis.

Basal plates slightly convex, extending little below the base of the first radials, depressed in the centre, the lower edges not extending downwards.

First radials large, height and width nearly equal. Second radials small, wider than high, quadrangular. Third radials a little longer than the second, pentangular, supporting a double series of supraradials, which support a double series of brachial plates above, the last brachial plate being protuberant. Arm-formula :

$$\begin{array}{c}4\\ \hline 4\quad 4\\ \hline 4\quad 4\end{array} = 20 \text{ arms},$$

composed of a double series of minute interlocking plates. Surface finely granulose.

A worn specimen in Mr. WORTHEN'S collection, and one with arms in Mr. WHITE'S collection, correspond to the following description :

First interradial plate large, nine- or ten-sided, supporting two in the second range, with sometimes one in the third range. First anal plate large, heptagonal, a little higher than the first radials : three plates in the second range and three in the third range ; or sometimes two irregular ranges above the second, with two each with a single one above these.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus senarius (n. s.).

THE form of the body below the arms is that of a hemispherical cup having a slightly protruding rim around its base, depressed convex above, and marked by irregular grooves, which are a continuation of the depressions at the interbrachial spaces. Base deeply excavated for the reception of the column.

Basal plates of medium size, slightly protruding at their lower margin.

First radial plates hexagonal and heptagonal, wider than high ; upper and lower lateral angles about equal. Second radials regularly hexagonal, smaller than the first radials. Third radials hexagonal, truncated at top by an interbrachial plate of large size, and supporting on the upper sloping angles supraradials, which support on their outer angles brachial plates, and on the inner angles other supraradials, which support each two brachial plates ; making six arms to each ray, or

$$\begin{array}{c} 6 \\ \hline 6\quad 6 \\ \hline 6\quad 6 \end{array} = \text{30 arms in the entire specimen.}$$

Interradials eight, generally hexagonal in shape, arranged in order as one, two, two, two, and one ; gradually decreasing in size as they rise upwards. First anal plate hexagonal, with two in the second range, three in the third, and several smaller plates irregularly placed above, and passing up into the dome. Summit composed of many small polygonal plates. Anal aperture subcentral.

SURFACE markings like those of *A. ornatus* (Iowa Report, Vol. i, Part ii, pl. 10, f. 12) ;

From which species this differs somewhat in the form of the body being more ventricose, and in the number of arms, which in that species are eight, while this has six from each ray. The base of this one is also deeply excavated for the reception of the column, while in that one it is flat. In its arrangement of plates and arms, it bears much analogy with *A. ventricosus* of the Iowa Report, Vol. i, Part ii, p. 595. In form of body below the arms, it corresponds very closely with *A. moniliformis* of GOLDFUSS; but the dome is broader and less elevated, and the arm-formula different.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus sinuosus (n. s.).

BODY broadly turbinate below, terminating in a subcentral proboscis of medium size ; when viewed from the base upwards it is slightly pentalobate, caused by constrictions at the interradial and anal series, that of the anal series being much the deepest.

Basal plates of medium size, and symmetrically rounded from their upper edges to the margin of the rather small central depression for the attachment of the column.

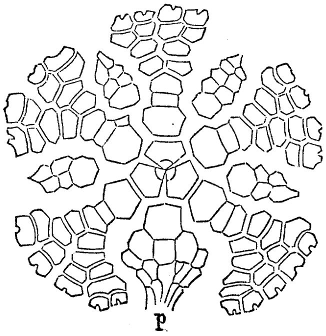
First radial plates wider than high, hexagonal and heptagonal. Second radials as wide again as high, quadrangular, except on the right postero-lateral ray pentagonal. Third radials short and wide, heptagonal in the anterior and antero-lateral, and hexagonal in the postero-lateral rays, and supporting on their upper sloping edges the supraradials in double series; the upper ones of these again supporting brachials in like manner, giving four arms to each ray except in the postero-lateral rays, where there is an intervening supraradial plate on the anal side, giving an additional arm to each of these rays, making the brachial formula

$$\begin{array}{c} 4 \\ \hline 4\quad 4 \\ \hline 5\quad 5 \end{array} = 22 \text{ arms.}$$

Interradial plates in the two anterior series, six or eight: first one eight-sided, of irregular form, supporting two smaller ones above, which are surmounted by two more in the third range and two in the fourth range; the upper one is elongated, and extends into the interbrachial spaces; those of the lateral series are but five in number, of forms similar to the others, and arranged in ranges of one, two and two, the fourth range being absent.

First anal plate large, heptagonal, supporting on its upper edges three smaller plates in the second range : above these the plates are small and irregular, forming the deep constriction of the anal side, and uniting in an abrupt depression of the dome.

Surface of plates smooth : minute surface structure very finely granulose.



Actinocrinus sinuosus.

This crinoid is readily distinguished by its peculiar form and the deep anal constriction, from any other species yet noticed in the strata of the same age.

Geological formation and locality. In the Burlington limestone : Burlington, Io.

Actinocrinus coronatus (n. s.).

Body somewhat globose, truncate at base and flattened at top, spinose, coronated.

Basal plates very large; the lower margins or centres of each produced into a salient ridge overhanging the broad cupshaped cavity below, in the centre of which the small column was deeply set.

First radials large, as wide again as high; the upper edges rather deeply concave, for the reception of the second radials, which are short and broad, of medium size. Third radials smaller than the second, pentangular except in the postero-lateral rays, where they are triangular, the brachial plates reaching down and truncating the upper angle of the otherwise quadrangular second radials. The brachial plates rest immediately upon the sloping edges of the third radials in single series only, except on the anal side of each postero-lateral ray, where there is one supraradial plate, giving one more arm to each of those rays, making the brachial formula as follows:

$$\begin{array}{c}\underline{\quad 2 \quad}\\ \underline{2\quad 2}\\ 3\quad 3\end{array} = 12 \text{ arms.}$$

Interradial plates single, large, seven- or eight-sided. Anal plates four; first one large, heptagonal, supporting the other three in the second series.

Surface of plates nodose, those of the first radials being a transverse ridge almost the size of the entire plate; those of the interradials and anal plates are produced into a short spine. The plates of the dome are nodose, with the central one, and one immediately over the centre of each ray having a short spine, which gives to the crinoid a coronated appearance. Anal aperture opening upwards at the base of the central spine.

This species is readily distinguished from *A. unicornis*, and its congeners, by the large and spreading basal plates, as well as the flattened and coronated summit.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

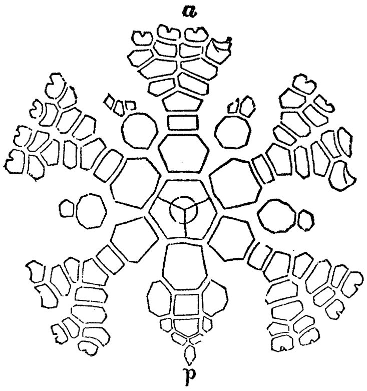
Actinocrinus papillatus (n. s.).

Subturbinate below, with a broad rounded base which is moderately depressed in the centre : the basal plates are flattened below, and scarcely extend beneath the plane of the bases of the first radial plates.

First radials large, convex, a little wider than high, slightly concave on their upper margins. Second radials short, quadrangular, nearly twice as wide as high. Third radials small, pentagonal, supporting on each of their upper sloping sides supraradial plates in double series ; the upper ones being five-, six- or seven-sided, and supporting the brachial plates, of which there are four from each ray, giving origin to as many arms which commence at the body of the fossil. Arm formula :

$$\frac{\dfrac{4}{4\quad 4}}{4\quad 4} = 20.$$

First interradial plate large, nine- or ten-sided, with one or two plates in the second range. First anal plate large, longer than the first radial plates; succeeded by three smaller plates in the second and three in the third range, the central one of which is much longer than the others, while there are one or two small plates in the fourth range. Entire surface granulose or striato-granulose.



Actinocrinus papillatus.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus formosus (n. s.).

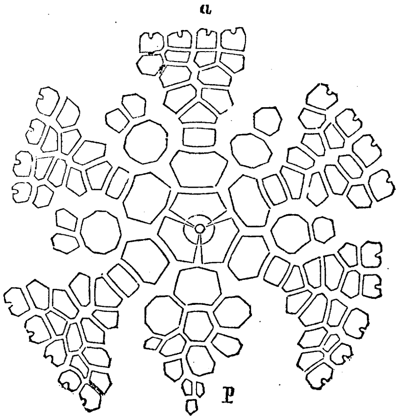
Body somewhat biturbinate, the lower part bearing the greatest proportion to the whole. Basal plates projecting a little below the top of the column.

First radial plates large, wider than high, hexagonal and heptagonal; the upper edges concave. Second radials small, quadrangular, twice as broad as high. Third radials small, pentagonal, supporting on their upper sloping edges the supraradials in double series, the second of which supports the brachial plates also in double series; which gives four brachial plates in double series on the anterior and antero-lateral rays, while in the postero-lateral rays there is a third supraradial plate intervening on the anal side, giving origin to an additional arm to each of those rays, making in all twenty-two arms:

$$\begin{array}{c} 4 \\ \hline 4\quad 4 \\ \hline 5\quad 5 \end{array} = 22.$$

Interradial plates two to three; first one large, wider than high, nine- or ten-sided: second range, one large or two smaller ones. Anal series consisting of eleven plates; first one large, pentagonal, supporting on its upper angles the second range of three smaller plates, which in turn support the third range, consisting of four plates with smaller plates above. (The anal series above the second range is probably variable.)

Surface of plates rising into low rounded nodes, those of the first radial and first interradial plates being the most conspicuous. Summit regularly convex, composed of tuberculose polygonal plates.



Actinocrinus formosus.

Proboscis subcentral, of medium size, the plates of which are slightly spinose. Column round, composed of alternating thicker and thinner joints : central perforation small, pentagonal. Entire surface finely granulose.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus pendens (n. s.).

Body cupshaped, subhemispheric below the arms : base depressed. Basal plates small, short, forming a narrow interrupted rim around the summit of the column ; the continuity of the rim broken at the sutures by two of the radials and the first anal plate, the bases of which project within the area of the column.

First radials large, wider than high ; upper margins concave. Second radials quadrangular except in the anterior ray, very short ; upper and lower margins convex : the anterior ray becomes elliptical, by the meeting of the angles of the first and third radials. Third radials much larger than the second, pentangular, supporting on each of their upper sloping edges brachial plates, except on the anal side of the postero-lateral rays, where they support bifurcating supraradial plates, which, on each side, support brachial plates, giving three arms to each of these rays and two to each of the others ; making the arm-formula

$$\frac{\frac{2}{2\quad 2}}{3\quad 3} = 12.$$

First interradial plates large, eight-, nine-, and eleven-sided, supporting a single smaller elongate plate above.

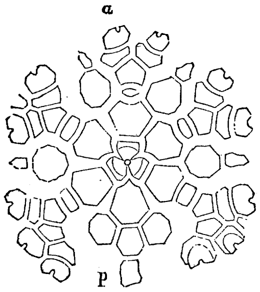
First anal plate large, heptagonal, supporting three smaller plates in the second range, the second one of which is hexagonal and the other two heptagonal ; and above this a single quadrangular plate lies between the bases of the arms.

Column round, rather small : canal pentagonal or pentalobate.

Surface of plates strongly nodose; the nodes of the first radials and first anal plate elongate and subclavate, being contracted in the middle and swelling out at the extremities, extending considerably below the plane of the summit of the column : nodes of the first brachial plates subcrescentform.

This is a very distinct and beautiful species, readily recognized by the very prominent character of the nodes.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.



Actinocrinus pendens.

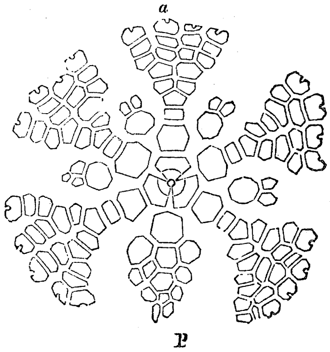
Actinocrinus lepidus (n. s.).

Body broadly subturbinate, abruptly spreading above the third radial plates : summit depressed-convex, with a central proboscis rising abruptly from the dome. Basal plates short, thickened at the lower margins, and slightly excavated for the attachment of the column.

First radial plates of medium size, a little wider than high. Second radials small, quadrangular. Third radial small, pentagonal, supporting on each upper oblique side a brachial plate, which is succeeded by a second one, on the sloping sides of which succeed three brachial plates, except on the anal side of the postero-lateral ray, where the upper supraradial sustains two supraradials of the second order, the last one a bifurcating plate supporting two brachial plates, and giving one more arm to this ray; making the brachial formula

$$\frac{\frac{4}{4\quad 4}}{5\quad 5} = 22 \text{ arms.}$$

First interradial ten-sided, supporting two smaller ones in the second range, which are arched above by the brachial plates of the adjacent arms. First anal plates heptagonal, about equal to the first radial plates, supporting three small plates in the second range, which are respectively six-, seven- and eight-sided; three plates in the third range, with an intercalated plate between the two ranges; three small plates in the fourth range, and two small elongated plates extending upwards and separating the brachial plates of the postero-lateral rays. Plates of the body very slightly convex, becoming more convex towards the bases of the arms : plates of the summit tuberculous. Column comparatively large.



Actinocrinus lepidus.

This species, in its general form, resembles *A. æqualis;* but the plates of the body are not tuberculous, the summit less elevated, and the arm-formula very different. In the arm-formula it resembles *A. turbinatus,* var. *elegans,* but differs in form of body and in the less elevated summit, while it has one more range of brachial plates forming part of the body. In this species, a right line from the base of the dome to the bases of the arms shows the outline of the body to be below it, or concave; while in *A. turbinatus,* the outline is straight or slightly convex.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus rudis (n. s.).

Body urnshaped, gradually expanding from the base to the top of the first radial, above which the sides are nearly vertical to the top of the third radial plate; from which point they expand more rapidly, forming a rim, upon the edge of which the arms were probably supported. Basal plates large, irregularly thickened, and projecting somewhat below the top of the column.

First radial plates very large; height and breadth nearly equal. Second radials less than half the size of the first, usually hexagonal. Third radials smaller than the second, much wider than high, heptagonal in form so far as can be determined from the specimen; supporting upon each of the upper sloping faces a single supraradial, which in turn supports two other plates, one a supraradial which supports two smaller plates above, and the other a brachial plate. There have probably been other bifurcations of the ray before reaching the bases of the arms; but from the imperfect state of the specimen, the numbers cannot be determined.

Interradial series consisting of about four plates to each set; the first one largest, equal in size or greater than the second radial, hexagonal or heptagonal, supporting two smaller plates in the second range and one in the third, the whole series being arched over by the plates of the adjacent rays. Anal series undeterminable.

Surface of plates profoundly sculptured into high irregular ridges separated by deep pits, which, although there is a general tendency of the ridges toward the faces of the plates, have nevertheless a rough, broken, and irregular appearance, as of having been extensively corroded. The basal and first radial plates are marked by several ridges which generally unite at or near the middle of the plate in a prominent node, the center of which is depressed into a deep subcircular pit; those of the other plates, to the height of the third radials, are elevated in the middle into prominent subspines or transverse ridges. The plates above the third radials are marked by a series of angular zigzag ridges, which follow the different ramifications of the rays, and are essentially separated from the transverse nodes of the lower plates by a deep groove running horizontally around the cup at the level of the top of the third radial plates.

Dome and number of arms unknown.

Geological formation and locality. In the Burlington limestone: Burlington, Iowa.

Actinocrinus tholus (n. s.).

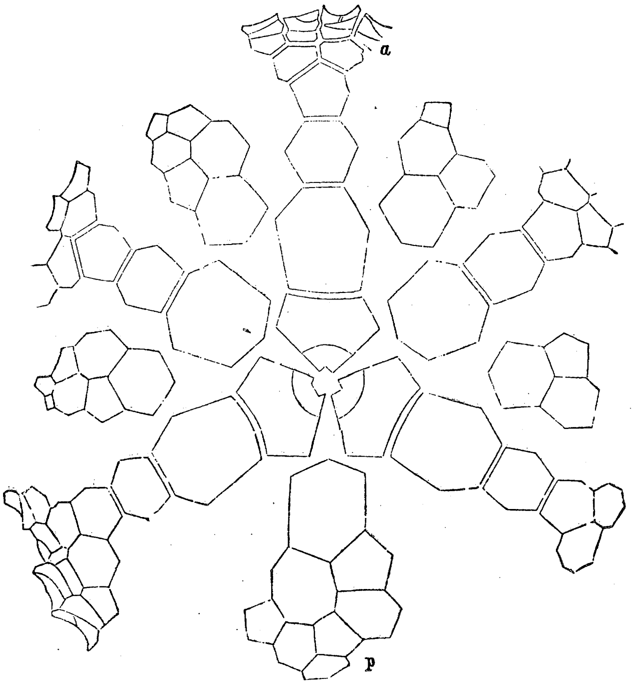
Body urnshaped, gradually spreading above to the base of the arms, where it is abruptly expanded : the dome is highly arched, with a large central proboscis. Basal plates truncate, projecting below the summit of, and embracing the upper joints of the column : basal plates thick and strong, grooved at the suture-line on the outside, the inner edges joining to their base.

First radial plates large, higher than wide. Second radials comparatively small, hexagonal. Third radials a little smaller than the second, hexagonal, and supporting on the upper sloping faces secondary plates in single series, from which proceed the brachial plates supporting the arms to the number of four from each ray. The brachial plates form part of the walls of the body, and the arms proceed directly therefrom in a double series of plates, making them simple from their origin.

Interradial plates six; the first one hexagonal, supporting two in the second range and a like number in the third, with a single small one in the fourth range. First anal plate large, hexagonal; the second range consisting of two and the third of four unequal plates, with one small plate in the fourth range, the brachial plates succeeding.

Surface nodose or tuberculous; the first radial plates marked by several nodes, which are irregularly confluent; the succeeding plates each marked by a single central transverse node : plates of the dome each marked by a prominent rounded or oblong node. Column round, large, with a large pentagonal perforation.

This species bears some resemblance to the *A. agassizi* of Troost; but this is more elongate, while that has a double range of supraradial plates. The *A. tholus* differs from *A. urna* of Troost in the form of the basal plates, in the structure of the supraradial part of the body, and in the much more elevated dome.



Actinocrinus tholus.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus divergens (n. s.).

Body depressed, subdiscoid below. Dome elevated and surmounted by a central and lateral spines, the lateral ones being nodose and bifurcate. Basal plates forming a protruding hexagonal disc; the area for the attachment of the column large, slightly depressed.

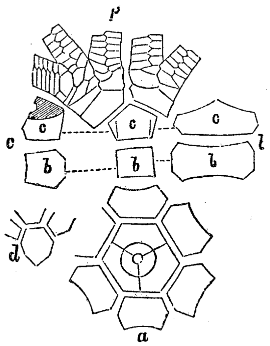
First radial plates hexagonal from the straightness of the lower margin, about once and a half as wide as high. Second radials short and wide, hexagonal and heptagonal, spreading horizontally or at right angles to the direction of the axis. Third radials heptagonal, much wider than high : the lateral margins of these, and of the second radials, are strongly inflected. The third radials support on their upper sloping edges a pair of large supraradial plates, which, in one of the postero-lateral rays, give origin to two arms on one side, and, on the side adjacent to the anal area, to three arms, making five arms from one of the postero-lateral rays ; the arm-formula being probably

$$\begin{array}{c} 4 \\ \hline 4\quad 4 \\ \hline 5\quad 5 \end{array}.$$

The arms differ, at their origin, from most of the forms of ACTINOCRINUS; being composed of a double series of interlocking plates below the last bifurcation, giving the arm altogether the appearance of the arm of PLATYCRINUS.

Interradial plates consisting of two ranges, the lower one of a single seven-sided plate supporting three plates in the second range. First anal plate smaller than the first radial plate, seven-sided, supporting three larger plates in the second range.

This species has a very remarkable form for an ACTINOCRINUS: the body consists of a shallow cup; the rays diverge from the second radial plates rectangularly, these plates and the third radials being broadly and deeply excavated on their inner sides, and probably occupied by the viscera of the animal as far as the first bifurcation. The arms are long and spreading, and, in the specimen examined, are curved in a horizontal direction. The dome is broken, and the form and arrangement of plates cannot be fully determined. It is clear, however, that the summit was crowned by a central strong spine, which was surrounded by others (probably five) without intervening plates, two of which still remain; these latter are divided at their summits, and tuberculous on their sides. There have been several ranges of plates between the bases of the outer spines and the axils of the arms.



ACTINOCRINUS DIVERGENS.

The diagram illustrates the structure of the base and first radials *a*, and one ray continued to the arm-bases *b c*, while *b c* on the right show the form of these plates if spread out, and *b c* on the left are sections of the same; *d* being the interradial series as far as seen in that specimen.

Since this diagram was made, several other specimens have been seen, consisting of the base, first and second radials, interradial and anal series.

The general aspect of the species is that of CYATHOCRINUS.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Actinocrinus oblatus (n. s.).

BODY depressed globose ; height to the summit of the dome a little more than two-thirds the width, the height of the dome being greater than that of the body below the bases of the arms. Basal plates small, and scarcely projecting beyond the general curve of the lower side of the body.

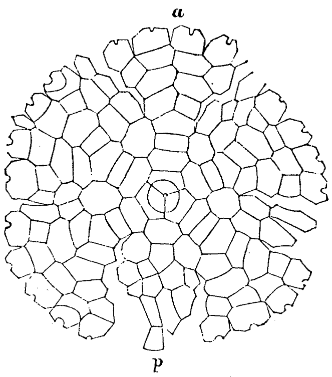
First radials short and broad, as wide again as high, concave on their upper margins. Second radials quadrangular, as wide again as high, about two-thirds as large as the first radials. Third radials hexagonal and heptagonal, about as large as the first radials, much wider than high, supporting on each of their upper sloping edges a double range of supraradial plates, which are very large in proportion to the plates below; the upper ones being larger than the third radials, and are bifurcating plates, supporting on each of their upper sloping edges two brachial plates, giving four arms to each ray :

$$\frac{\dfrac{4}{4\quad 4}}{4\quad 4} = 20.$$

First interradial plates of medium size and irregular in form, being eight-, nine- and ten-sided; supporting two smaller elongated plates in the second range and two in the third, the latter being usually much elongated, reaching as high as the upper fixed brachial plate.

First anal plate heptagonal, higher but not as wide as the first radials, supporting three slightly smaller plates in the second range; the central one hexagonal (being slightly truncated above), the others octagonal. Above these are ten irregularly shaped plates in about three ranges, the upper ones being elongated.

This species is of the type of *A. rotundus* of YANDELL and SHUMARD. In this species, however, the number of interradial and anal plates is much greater, giving a greater width to the body, which is more flattened below than in true *A. rotundus*. In that species the interradial series is one and two, above which come the brachial plates of adjacent rays; while in the one here described, the arm-bases are separated by one or two plates. In the *A. rotundus* the proboscis is more strongly marked, rising from the centre of an elevated dome; while the dome of *A. oblatus* is less elevated, and the proboscis, if existing at all, has been much smaller.



ACTINOCRINUS OBLATUS.

The number of arms given in the original description of *A. rotundus* is twenty-one, which is not a regular number; and we suppose the arm-formula to be

$$\begin{array}{c} 4 \\ \hline 4\quad 4 \\ \hline 5\quad 5 \end{array},$$

as we have found in well-marked forms of that type which have the other characters of the species as given by its authors.

Geological formation and locality. In the Burlington limestone at Burlington in Iowa, and at Rocheford in Missouri.

Actinocrinus mundulus (n. s.).

BODY urnshaped below, conical and gradually tapering above to a strong subcentral proboscis : base truncate, deeply excavated for the reception of a proportionally large column. Basal plates very short, thickened into a flat ring which surrounds the column. First radials of medium size, wider than high. Second radials small, quadrangular; height two-thirds the width. Third radials equaling or smaller than the second, pentagonal or hexagonal, sustaining on their upper oblique edges supraradials in double series; the superior of these supporting each two brachials, giving four arms to each ray :

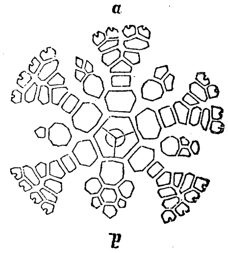
$$\begin{array}{c} 4 \\ \hline 4\quad 4 \\ \hline 4\quad 4 \end{array} = 20.$$

First interradial plate larger than the second or third radials, nine- or ten-sided, sustaining one or two small plates in the second range. First anal plate smaller than the first radials, heptagonal, supporting three smaller heptagonal plates in the second range; with three small plates above, completing the series.

Surface of plates below the arms smooth, having the suture lines slightly depressed; those of the summit small, polygonal, nodose.

This small species is symmetrically urnshaped below, with the sides a little convex: the arms are symmetrically arranged, without depressions at the interbrachial spaces; the dome is conical, graduating into the proboscis without any defined line of demarcation between them.

Geological position and locality. In the Keokuk limestone, Warsaw, Illinois.



Actinocrinus mundulus.

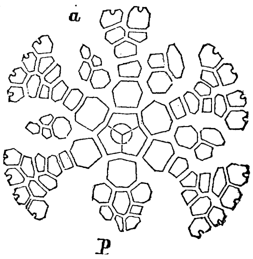
Actinocrinus similis (n. s.).

Body turbinate below, depressed-conical above, terminating in a strong central proboscis: base truncate, excavated for the reception of the column. Basal plates short, thick. First radials large, wider than high. Second radials small, quadrangular or pentangular. Third radials five- or six-sided; supporting upon their superior oblique edges, brachial plates in double series in the anterior ray, and, in the remaining ray, supraradials in double series; these in turn sustaining each two brachial plates in single series, giving two arms to the anterior ray and four to each of the other rays:

$$\frac{\frac{2}{4\ \ 4}}{4\ \ 4} = 18 \text{ arms.}$$

Interradial plates four; the first large, heptagonal, sustaining two smaller plates in the second range and one in the third (the third sometimes anchylosed with one of the second, making a large plate). Anal plates eight, the first one equaling the first radials in size, heptagonal; sustaining three heptagonal plates in the second series and four irregular ones in the third, the uppermost of them being elongated and reaching into the interbrachial space above. Interbrachial spaces somewhat indented, giving the crinoid a slightly lobate form.

Surface smooth below the arms, and nodose above.



Actinocrinus similis.

This species somewhat resembles *A. mundulus*, but differs in the general form of the body, in its lobate appearance, and in the number of arms.

Geological position and locality. In the Keokuk limestone, Warsaw, Illinois.

Actinocrinus lagunculus (n. s.).

Body small, turbinate below and somewhat flattened on the anal side, conical above, rising gradually from the arm-bases to the base of a strong but rapidly tapering subcentral proboscis: base truncate. Basal plates very short, thickened at their lower margins and forming a rim around the bottom of the calyx, not indented at the suture-lines.

First radial plates once and a half as wide as high, concave at the top, the lower margin scarcely convex. Second radials small, wider than high, quadrangular. Third radials pentangular, except in the postero-lateral rays, where they are hexagonal; the additional angle being on the side next the interradial area. Upon the upper sloping sides of the third radial plates, in the anterior and postero-lateral rays, there rest brachial plates in double series on the one side, and upon the other a supraradial plate, which sustains two other brachial plates, giving three arms to each of these rays; while in the antero-lateral rays, the third radial plate sustains on each sloping edge a double series of supraradial plates, which sustain upon each of their oblique edges a single brachial plate, giving these rays four arms each; making the arm formula

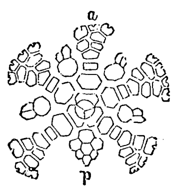
$$\begin{array}{c} 3 \\ \hline 4\quad 4 \\ \hline 3\quad 3 \end{array} = 17 \text{ arms.}$$

First interradial plate large, nine- or ten-sided, giving support to two small irregularly-formed plates in the second range. First anal plate heptagonal, smaller than the first radial, but equally as high; supporting three smaller hexagonal plates in the second range and three in the third range, the brachial plates of the postero-lateral rays joining above.

Surface of the plates of the calyx slightly elevated and forming low angular nodes, having the direction of the longest diameter of the plate.

Summit composed of nodose plates, which are smallest near the arm-bases, and increase in size as they approach the base of the proboscis.

This small species differs from *A. mundulus* in the body being less symmetrical, and in having the ridge-like nodes upon the plates of the calyx, while those of that species are smooth. The number and arrangement of the arms are also different; those of that species being four to each ray, making twenty in all, while these are only seventeen. It differs in the same points, but in a different manner, from *A. similis*, as may be seen by comparison with the description of that species.



ACTINOCRINUS LAGUNCULUS.

Geological formation and locality. In the Keokuk limestone: Warsaw, Illinois.

Actinocrinus steropes (n. s.).

Body symmetrically urnform, with the dome-like summit terminating in a strong central proboscis : base truncate, and excavated for the reception of the column. Basal plates of moderate size, thickened at their lower margins into a slightly protruding ridge.

First radial plates a little wider than high, not large, deeply concave on their upper margins. Second radials quadrangular, wider than high. Third radials pentangular, supporting on their upper oblique edges a pair of proportionally large supraradials (except in the anterior ray) : these sustain upon each of their upper sloping edges large brachial plates in double series, which gives four arms to each of these rays.

The plates on the anterior ray of the specimen examined have been broken away; but from the space which they have occupied, there cannot have been more than two arms, which would make the brachial formula

$$\begin{array}{c} 2 \\ \hline 4\quad 4 \\ \hline 4\quad 4 \end{array} = 18 \text{ arms.}$$

The interradial areas are occupied by a single plate; those of the anterior areas being octagonal, and those of the posterior areas nine-sided : the last have their transverse and longitudinal diameters nearly equal, and have a general subcircular form; the others are more elongated. First anal plate heptagonal, as large as the first radials, supporting three other plates in the second range, one of which is six-, one seven-, and the other eight-sided; the central one largest, being larger than the interradial plate, while the others are smaller. Besides these there are two other small plates, one above the centre of the series, and another in the upper angle on the right side of the second range. The brachial plates of the adjoining rays unite above, and arch over the anal area.

Surface of plates slightly tuberculous; some of those of the dome becoming subspinose.

This species has considerable resemblance to *A. agassizi* of Troost, but differs in having a more elongated form; the plates of the body are much larger, and of less number between the third radials and the arm openings. The brachial formula of *A. agassizi* is

$$\begin{array}{cc} \multicolumn{2}{c}{4} \\ \hline 4 & 4 \\ \hline 5 & 5 \end{array} = 22 \text{ arms,}$$

while this species has but eighteen. There are other and important differences to be found in the greater number of the interradial and anal plates of that species. It differs from *A. tholus* of the Burlington limestone, in not having the large first radial plates of that species, nor the great number of interradial and anal plates, as well as in the form and surface markings of the plates of the entire body, and a less number of arms to the anterior ray.

Geological formatton and locality. In the Keokuk limestone, opposite to Keokuk, east of the Mississippi river.

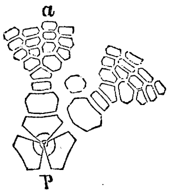
Actinocrinus clavigerus (n. s.).

Body short clavate, the sides rising nearly parallel to the bases of the third radial plate, at which point they are abruptly deflected almost at right angles to the axis, the deflection extending to the arm-bases. Dome hemispherical and composed of large tuberculose and subspinose plates, broadly truncate at base. Basal plates rather short, thickened at their lower margins and indented at the suture-lines.

First radial plates very large in proportion to those above, concave at top. Second radials extremely small, more than twice as wide as high. Third radials little larger than the second, pentangular, sustaining on each of their upper oblique edges a single supraradial plate of double their own proportions, while these sustain on each of their oblique edges a double or triple series of brachial plates.

Interradial series consisting of a single eight- or nine-sided plate of moderate size, rather elongated in form. Anal series undeterminable.

The surface of the third radial plates protruding, forming a transverse node; that of the other plates of the calyx is comparatively smooth.



ACTINOCRINUS CLAVIGERUS.

The hemispherical dome is surmounted by a small subcentral proboscis, excentric on the anal side. Arms symmetrically arranged, being four from each ray.

Geological formation and locality. In the Keokuk limestone: Nauvoo, Illinois.

Actinocrinus planodiscus (n. s.).

BODY discoid, extremely depressed; the lower side scarcely convex from the periphery to the first radial plates, which, with the basal plates, form a projecting center to the otherwise flat disc. Basal plates very short.

The plates of the radial series are very small in comparison with the size of the specimen: the first are the largest, being much wider than high; the second are quadrangular, wider than high; the third, heptagonal, and support on their upper sloping edges supraradials in double, and in one place a triple series: the uppermost of these are bifurcating plates, and support on their oblique edges other series of supraradial plates of the second order, which are usually as large as the second and third radials; the series consisting of from two to four plates, the last of which is also a bifurcating plate, and gives support to one or two brachial plates on each of their oblique edges; which arrangement gives to each ray eight arms:

$$\begin{array}{c} 8 \\ \hline 8\quad 8 \\ \hline 8\quad 8 \end{array} = 40.$$

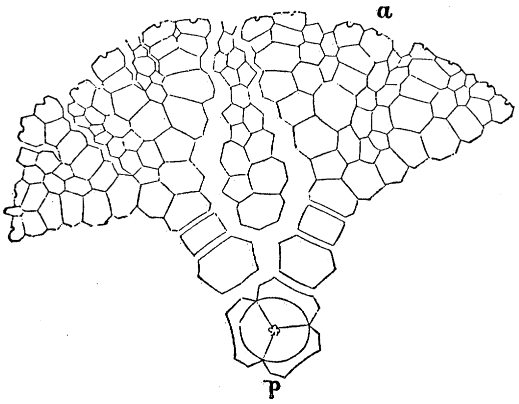
The interradial series consists of fourteen plates : the first five or six are equal in size to the first supraradials; the remainder being much smaller, and extending to the periphery of the disc. Inter-supraradials eleven or twelve. Axillary plates four or five, the outermost of which, as well as those of the last-mentioned spaces, curve over to the edge of the disc, separating the arms into pairs. Anal plates unknown.

Surface of plates granulose.

This species of ACTINOCRINUS is remarkable for its resemblance to some forms of FORBESIOCRINUS found in the same geological position : indeed so similar are they in the number and arrangement of the plates above the third radials, that this specimen might very naturally be mistaken for a crushed specimen of that genus. The similarity is also increased by the slight depression of the interradial and interbrachial spaces; but the existence of only three basal plates, and the absence of subradials, places it at once in the Genus ACTINOCRINUS.

This is the first species of its genus noticed, which possesses more than two plates in direct succession between the bifurcations of the ray; this being one of the most striking features of FORBESIOCRINUS.

The body of this species, to the summit of the third radials, is small, and forms but a subordinate part of the whole. From a little below the top of the third radial plates it expands abruptly outwards, spreading almost rectangularly to the axis, and forming a disc of about two and a half inches in diameter. The summit is imbedded in stone, so that we have no knowledge of this part of the fossil.



ACTINOCRINUS PLANODISCUS.

Geological formation and locality. In the Keokuk limestone : Nauvoo, Illinois.

Actinocrinus brontes (n. s.).

Body large, turbinate ; the arms spreading from the body at the third radial plate, and forming by their bases expanding lobes, which give to the specimen a pentalobate form. Base truncate, and excavated for the reception of the column, which appears to have been proportionally large.

Basal plates large, their height equal to two-thirds that of the first radials, thickened at the lower margin into a deeply sculptured transverse node.

First radial plates large in proportion to the plates above; the height and width of those of the anterior and antero-lateral rays about equal, while those of the other rays are much narrower than high. Second radials small, hexagonal in form. Third radials smaller than the second, pentagonal, and supporting on each of their upper sloping edges a supra-radial plate of large size, which give support on their outer edges to a series of brachial plates, and on their inner edges to other supraradials of a single and sometimes a double range; the last of which bears upon each of its sloping edges brachial plates, giving six arms to each of the rays.

First interradial plate hexagonal, larger than the second radials, supporting two smaller hexagonal plates in the second range.

First anal plate hexagonal, as high but not as wide as the first radials, sustaining two smaller hexagonal plates in the second range, which equal in size the first interradials : those of the third range are three in number, and of smaller size.

The surfaces of the first radial plates have a general convexity, being more strongly elevated in the centre. This elevation is marked by four rather deep pits arranged quadrangularly, two above and two below separated by a transverse ridge : from these pits the surface of the plate is traversed by low ridges, uniting with those of the adjoining plates; six of them pass downwards and unite with those of the basal plates, three from each side to those of the other first radial plates, two or three to each of the first interradial plates, and three to the second radial plate above. These lines, on the interradial and all but the first radial and anal plate, meet in the center and form a solid node.

Summit unknown.

This species bears some resemblance to *A. humboldti* of TROOST, but differs essentially in its more angular form and the produced nodes of the first radial plates, and the more spreading lobes at the base of the arms.

Geological formation and locality. In the Keokuk limestone : Nauvoo, Illinois.

Actinocrinus unicarinatus (n. s.).

BODY turbinate below the arms, and convex above : arm-bases very prominent. Basal plates large, projecting below the junction of the column, and slightly notched at the suture-lines.

First radials large, hexagonal and heptagonal, considerably higher than wide. Second radials hexagonal; width once and a half the height. Third radials small, heptagonal, supporting on each upper oblique edge a single supraradial plate, which in turn support on each side brachial plates; giving only four arms to each ray, as far as the plates are preserved in the specimen. (In one of the rays the arrangement of the plates is slightly different, but the result is the same in the single specimen examined.)

First interradial plate regularly hexagonal, equal in size to the second radials, supporting two smaller plates in the second range and three in the third. First anal plate hexagonal, smaller than the first radials, supporting two hexagonal plates in the second range, which are a little smaller than the first interradials, with three in the third range; the space above, opening upon the summit, composed of small polygonal plates.

Dome composed of small polygonal plates, some of which are slightly nodose. Proboscis subcentral, strong. Column large : central perforation pentalobate.

The surface-markings consist of a simple set of indistinct ridges, which pass from plate to plate, and form low angular nodes in the centre of the principal ones.

This specimen, in the simple set of ridges, finds its nearest analogue in *A. lowei*; but the form of the body is entirely different, the diameter at the point where the arm-bases separate into lobes being about one-third less in proportion to the height; while the elongated forms of that and the allied species have generally a double, triple, and in some parts a quadruple set of ridges, which, on meeting in the centre of the plates, always form transverse nodes on those plates which are not equal-sided. The simple set nearly always form a round node.

Geological formation and locality. In the Keokuk limestone : Nauvoo, Illinois.

Actinocrinus jugosus (n. s.).

Body elongate-urnshaped, the arms divided into lobes by the depression of the interbrachial spaces; each of these lobes, which consists of one of the rays, is subdivided into smaller lobes, the central larger than the outer ones. Base truncate, concave below.

Basal plates short and wide, thickened below, deeply notched at the vertical suture-lines, deeply indented towards the upper margin, and joining the first radial plates by three or four strong ridges.

First radial plates large, higher than wide. Second radials of medium size, hexagonal; height little greater than the width. Third radials elongate, heptagonal, smaller than the second radials, supporting on their upper oblique edges large supraradial plates, which sustain brachials on the outer oblique edges, and, on the inner, other supraradials in a double range : the upper one of these supports on the inner edges brachial plates, while on the outer there rests a series of two supraradial plates of the third order; the upper one of these supports two sets of brachial plates. This arrangement gives to each ray eight arms, or

$$\frac{\frac{8}{8\quad 8}}{8\quad 8} = 40 \text{ arms.}$$

The first interradial plate is nearly symmetrically hexagonal, as large as the second radial, sustaining on its upper edges two hexagonal plates but little smaller than the first. The third range is composed of three, and (in this specimen) one series of four smaller irregularly-formed plates; while other small plates occupy the interbrachial spaces.

First anal plate hexagonal, small, half as large as the first radial, once and a half as high as wide. Second anal plates hexagonal and heptagonal, equalling in size the second radials; with four smaller plates in the third range, and two above in the fourth range between the brachial plates of the adjacent rays.

Surface of plates traversed by ridges, which, meeting on their centres, form nodes on the first radials : from the lower side of these are four strong ridges, which, passing downwards, unite with those of the basal plates; three from the upper side, uniting with those of the first interradial plates; and three from the top of the node, which pass over the second radial plates, after forming with others the central node, and unite in the node of the third radial plate. The ridges traversing the surface of the interradial plates are single, strong ridges. The nodes on the plates of the radial series are transverse; those of the interradial and anal series are small, round, and highly elevated.

The summit of the specimen is conical, rising gradually from the bases of the arms to the base of the strong central proboscis; the whole being composed of tuberculiferous plates, the tubercles highly elevated.

This crinoid is of the type of *A. humboldti* of Troost, but differs materially from any other heretofore described in the elongation of the cup, the form and proportions of plates, the surface markings, and the number and mode of bifurcation of the arms.

Geological formation and locality. In the Keokuk limestone : Warsaw, Illinois.

Actinocrinus lobatus (n. s.).

Body large, subturbinate below, irregularly convex above, distinctly divided into lobes by the depression of the interbrachial and anal spaces, which are very large and flattened, giving the specimen a peculiar pentalobate appearance when viewed from the base upwards, or from the summit.

Basal plates proportionally large, thickened at their lower margins, and slightly overhanging the top of the column.

First radial plates large; length and width about equal. Second radials of medium size, symmetrically hexagonal. Third radials smaller, eight- or nine-sided, wider than high, supporting on their upper oblique edges short broad supraradial plates : these again support brachial plates on their outer oblique sides; while on their inner edges they sustain on the one side of the ray supraradial plates in two ranges, with brachial plates for two arms above, and on the other side they sustain brachial plates for one arm only, making five arms to the whole ray.

In the specimen examined, the only ray from which the number of arms can be determined, is a postero-lateral ray; which having, in nearly all the species of Actinocrinus, as many arms as any of the other rays, this species cannot have had more than twenty-five arms.

First interradial plate hexagonal, as large as the second radial, sustaining on its upper edges two smaller hexagonal plates in the second range, three in the third range, and four in the fourth range, with small plates forming a part of the summit.

First anal plate hexagonal, smaller than the first radials, supporting two smaller hexagonal plates in the second range, equal in size to the first interradial plates : the third range contains three plates; the fourth range contains four plates, braced on the outer sides by the first supraradial plates. The anal area above the fourth range of plates opens upon the summit of the specimen, and the plates may be considered as belonging to the dome rather than to the anal series.

Surface of plates traversed by sharp ridges, which, meeting in the centre of each plate, form nodes to the height of the radial series proper. The nodes of the radial series are transverse; those of the interradial and anal plates are round. The ridges from the first radials to the basal plates are four in number, while those from one first radial plate to the other are only two : the ridges from the first to the second radial are two, very strong; the remaining ridges are simple.

This species has its greatest affinities with *A. lowei* of the Iowa Report; but differs essentially in the form of the body, which is more angular and much higher in proportion to its width; the summit is more elevated, and the plates less tuberculose. The surface markings are also different, and the number of arms less.

Geological formation and locality. In the Keokuk limestone : Warsaw? Illinois.

Actinocrinus spinosulus (n. s.).

Body broadly calyculate below the bases of the arms, the arm-bases and bases of the spines above giving it a pentalobate aspect. Base broadly truncate : basal plates short and wide, their bases projecting laterally in a narrow rim.

First radial plates short and wide, the breadth being equal to twice the height. Second radials short and broad, quadrangular. Third radials short and broad, pentagonal and hexagonal, and, in the anterior and antero-lateral rays, supporting on one side a single bifurcating supraradial plate, and on the other side brachial plates. In the postero-lateral rays, the third radial supports, on each upper sloping side, a single bifurcating supraradial plate, which sustain on each of their upper faces a brachial series, giving four arms to each of these rays; making the arm-formula

$$\frac{\frac{3}{3\quad 3}}{4\quad 4} = 17 \text{ arms.}$$

First interradial plate ten-sided, and supporting two smaller elongated plates which reach as high as the arm-openings in the adjacent rays. First anal plate heptagonal, much narrower than the first radial plates, and supporting three plates in the second range, above which they are indeterminable.

Above each ray, and on the inner axil of the arms, there is a strong round and smooth spine, rising obliquely to the axis, and a single similar spine placed at the summit of the dome nearest the anal side.

Surface of the plates smooth or finely granulose, convex in the middle.

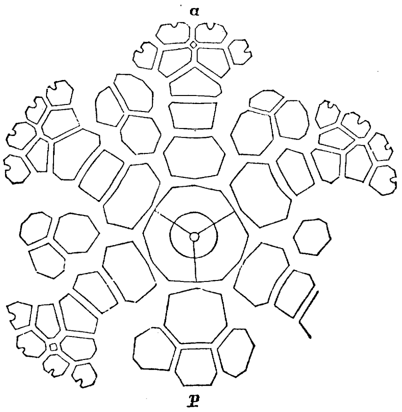
This species resembles the *Actinocrinus* (*Dorycrinus*) *mississippiensis* of Rœmer; but the body is smaller and proportionally shorter, and the number of arms in the rays is quite different, that one having four to each ray. In the specimen described, there is a slight irregularity in the right antero-lateral ray; which shows one arm less than the formula given.

This one, as well as the species of Rœmer, differs from the *A. gouldi* in the non-tuberculous plates and in the smooth spines, as well as other features of importance.

Geological formation and locality. In the Keokuk limestone at Nauvoo, Illinois.

Actinocrinus (Dorycrinus) mississippiensis, var. spiniger.

A well-formed specimen, smaller than the one figured by Dr. Rœmer, having the same form and arrangement of plates and the same arm-formula, has the lateral spines diverging rectangularly from the body, instead of rising at an angle of 40°. In the dome, there is but a single range of plates between the central spine and the bases of the postero-lateral spines, and two ranges between the central spine and the antero-lateral spines, thus differing essentially in this respect from the species of Dr. Rœmer. It is quite probable that this may prove a distinct specific form.



Actinocrinus (Dorycrinus) mississippiensis, var. spiniger.

Geological formation and locality. In the Keokuk limestone : Warsaw, Illinois.

Actinocrinus caroli (n. s.).

Body small, turbinate below : base prominent, the lower margins of the basal plates projecting laterally. Radial plates short, the second one quadrangular and twice as wide as long : third radials pentagonal, and supporting on each upper sloping side two secondary or supraradial plates, the second of which are pentagonal, and support on their upper sloping sides a series of two brachial plates, each of which gives origin to an arm-plate, making (so far as observed) four arms from each ray. Arms long, composed of a double series of short alternating plates, the adjacent faces of which are scarcely interlocking : tentacula at base, occupying very nearly the entire length of the arm-plate. First interradial plate ten-sided, wider above, and supporting on its upper side two smaller plates.

Column composed of alternating larger and smaller joints, and, farther from the body, of two, three or more smaller joints between the larger ones ; the edges of the joints sharply angular.

Surface granulose ; the radial plates marked by a longitudinal elevated ridge, which bifurcates on the secondary and again on the brachial plates.

This species resembles in some respects the *A. ramulosus* of the Keokuk limestone; but the ridge upon the radial plates is more angular and less prominent, while that one has three brachial plates below the point where the arms leave the body.

Geological formation and locality. In the Warsaw limestone : Warsaw, Illinois.

Actinocrinus calyculus (n. s.).

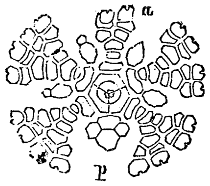
Body depressed turbinate below the arms and abruptly conical above, the proboscis a little excentric on the anal side : base rounded, the plates short, with the lower margins forming a projecting rim, within which is a shallow symmetrical depression for the reception of the column ; the edges of the plates a little elevated on each side the suture-line. Radial plates short, the second one often not fully developed ; the third radial supporting two series of secondaries or supraradials, of which the lower ones are quadrangular and the upper ones larger and pentagonal, each one of the latter supporting two brachial plates, and these each an arm-plate in direct succession, giving origin to four arms from each ray except the anterior ray, where there are but two arms, the secondaries proceeding in direct line to the arm-plates. First interradial plate ten- or eleven-sided : second interradial small, or sometimes not developed. First anal plate large, wider than long : second anal plates three, of which the central one is larger than the first radial, and supports in part the brachial plates of the adjacent rays.

Dome abruptly conical, composed of small acutely spiniferous plates. Proboscis undetermined.

Surface of plates marked by short undulating or subgranulose ridges, which have a general character of radiating from the centres of the plates.

This small species differs from any other in this rock, and, though approaching to some of the forms in the Burlington limestone, is nevertheless quite distinct.

Geological formation and locality. In the Warsaw limestone : Spergen hill, Indiana.



ACTINOCRINUS CALYCULUS.

Actinocrinus, Subgenus Agaricocrinus.

Agaricocrinus geometricus (n. s.).

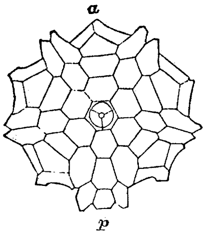
Body slightly concave beneath and hemispherical above, having the anal area greatly protruding beyond the hemispherical outline. Basal plates small, deeply depressed for the insertion of the column, and having the outer angles reaching a little beyond its circumference.

First radials hexagonal (from the straightness of the lower margins), a little wider than long; the upper lateral angles comparatively large. Second radials having the upper outer angles distinctly truncated by the second range of interradials, making them hexagonal (except on the anal side of the postero-lateral rays), nearly twice as wide as high. Third radials very broad, pentagonal, and supporting very short broad brachial plates, giving origin to two arms from each ray.

First interradial plates hexagonal, higher than wide, supporting two in the second range, which are of an elongate form and reach up to the centre of the arm-spaces. First arm plate hexagonal, narrower but as high as the first radials, supporting three larger plates in the second range ; the middle one being hexagonal, and the others octagonal. Anal area excessively protruding, composed of a large number of very small polygonal plates.

Surface of plates distinctly and very beautifully granulose; the central one of the dome, together with those adjoining it (except on the anal area) and one over the centre of each ray, elevated into rounded tubercles.

This species resembles most nearly the *Agaricocrinus stellatus;* the differences being principally in the absence of the angular ridge which marks the lower side of the body in that species, and also in the greater uniformity and symmetry of the plates composing the body. The straightness of the edges of the plates in this species is a marked and peculiar feature; there being scarcely a suture-line below those of the brachial plates, having the slightest curvature; and the opposite angles of the same plate have nearly the same proportions, except those adjoining the anal series.



AGARICOCRINUS GEOMETRICUS.

The feature last described is well shown in the diagram. It is scarcely necessary to compare this with other species described; since the characters mentioned, if at all constant, are sufficient to distingnish it. From *A. bullatus,* an allied species, it differs in the less concave base as well as the lower dome, which is composed of smaller and less strongly tuberculous plates.

Geological formation and locality. In the Burlington limestone: Quincy, Illinois.

Agaricocrinus pentagonus (n. s.).

BASE of specimen nearly flat from the edge of the last joint of the column to the junction of the second and third radial plates, at which point it becomes deflected upwards: the interradial and anal spaces are at right angles to the plane of the base, while the rays themselves are a little more protruding, giving to the outline of the body a pentagonal form. Basal plates very small, entirely concealed by the column, and depressed beneath the general level of the base.

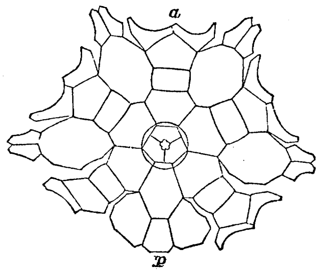
First radial plates hexagonal from the straightness of their lower margins, once and a half as wide as high; their lower margins very narrow. Second radials of moderate size, quadrangular; upper and lower margins straight, with convex lateral faces. Third radials pentangular, much wider than high, and supporting on their upper oblique edges short wide brachial plates, which are somewhat triangular in outline, with upper edge concave.

First interradial plates very large, double the size of the first radials and of an elongated form, supporting on their upper oblique edges two small elongated plates in the second range, which reach to the top of the arm-bases. First anal plate extremely elongated, supporting three other irregularly formed plates in the second range, the central one being the smallest.

Dome elevated, three-fourths as high as the width at the base of the specimen, composed of convex and tuberculiform plates, the central one being elevated into an obtuse spine; and a single plate in the axil of each pair of arms is very strongly tuberculose, while the central one is surrounded, except on the anal side, by a row of tuberculous plates.

This species may be readily distinguished from any other of this genus yet described, by the relative proportions of the plates; the first interradials being nearly double the size of any other species, in comparison with the size of the specimen, while all the other plates vary in proportion from those of other species.

Geological formation and locality. In the the Burlington limestone : Burlington, Iowa.



AGARICOCRINUS PENTAGONUS.

Agaricocrinus pentagonus, var. convexus.

BASE convex : arms small; all the plates of the dome tuberculose.

This variety differs from *A. pentagonus* proper in the characters above cited, and a larger collection of specimens may prove it to be a distinct species.

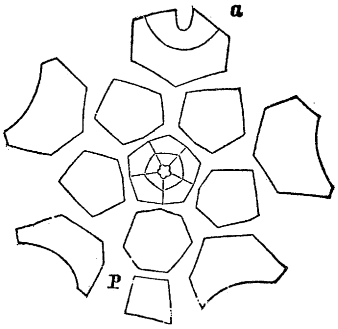
Cyathocrinus sculptilis (n. s.).

Body broadly basin-shaped; height to the summit of the first radial plates equal to two-thirds the diameter : base truncate, and the summit of the column deeply inserted. Basal plates short, spreading, regularly pentagonal in form, the apices bent inwards. Subradial plates hexagonal; height and breadth nearly equal. First radial plates large, more than twice as wide as high, three of them heptagonal and two hexagonal; the articulating faces very large, occupying the greater part of the width of the plate. First anal plate nearly as large as the subradials, heptagonal : second anal plate smaller, quadrangular, its upper margin being on a line with the summits of the adjacent radials.

Surface of the plates marked by broad strong ridges, which occupy the greater portion of the area. The basal plates are marked by a ridge on each side, which, uniting at the suture with corresponding elevations on the subradial plate, coalesce in one broad elevation near the base of that plate, and again subdivide above the middle, sending one division to each of the lower adjacent radial plates.

A short ridge extends from the lateral face of each of the radial plates, uniting at the suture with those of the adjacent plates. The direction of these ridges gives a series of lozenge-shaped depressions, which occupy the apex of the basal plate, the lateral margins of the adjacent subradials, and the lower angle at the centre of the base of the first radial plates; and a series of subtriangular depressions occupy the apices of the subradials, and lower lateral angles of the adjacent radial plates. The ridges, in well-preserved specimens, are marked by a set of sharp striæ parallel to their direction, while the depressions are finely granulose.

This species would appear to bear a close resemblance to the *Poteriocrinus rhombiferus* of Owen and Shumard; but the basal plates are always visible beyond the margin of the column, and are regularly pentagonal, while the second series are distinctly hexagonal, with the exception of the anal plate which is heptagonal. The first radial plates are much wider in proportion to their height : the faces joining the adjacent radials & subradials are four; the summit has a broader articulating face for the second radial, and the upper adjacent angles are truncated by the interradial plates, except those joining the anal plate.



CYATHOCRINUS SCULPTILIS.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Cyathocrinus crassibrachiatus (n. s.).

BODY strong, deeply cyathiform. Basal plates comparatively small, pentangular, somewhat acute above. Subradial plates large, gibbous on the surface, hexagonal. First radial plates large and somewhat convex in the middle, heptagonal, except one adjoining the anal side, which is octagonal; articulating face for the second radial occupying nearly four-fifths the entire width of the plate. Second radial plates broad and short; the arm bifurcating on the third radial, which is a short wide plate, subtriangular or pentagonal. Arms massive (as far as seen), composed of short strong plates. Column round, composed of thin subequal joints.

Surface of plates smooth.

This species is smaller, and the body is higher in proportion than the *C. magister*, and the individual convexity of the plates produces a much more unequal surface than in that species. The body is proportionally higher and more robust than that of *C. spurius*.

Geological formation and locality. In the Keokuk limestone : Warsaw, Illinois.

Cyathocrinus thomæ (n. s.).

Body rotund below, forming a deep cup. Basal plates short, the lower side a little protuberant, with a more or less distinct ridge extending from the base to each upper sloping side; the apices impressed. Subradial plates about as wide as long, convex in the centre, with a prominent rounded ridge extending to each side, meeting a similar ridge from adjacent plates; the intermediate spaces and angles concave. First radial plates wider than long, with the lower angles depressed, and a prominent converging ridge extending from each lower sloping side upwards and joining in a transverse rounded elevation (the latter not always conspicuous) below the upper margin, which is contracted. Second radial plates extremely short and very wide. Third radial plates triangular, narrower than the second radials, and allowing the arm-plates on each side to rest in part upon the second radial plates. Arms diverging, composed of short quadrangular plates with wedge-form plates at intervals, from which proceed branches.

Column round, strong, composed of alternating longer and shorter joints, which vary at different distances from the body. Surface granulose.

This species resembles in some degree the *C. protuberans* of the Keokuk limestone; but the plates are less protuberant in the centre, the angles more depressed, with more distinct ridges proceeding to the sides of the plates; while the third radials are proportionally much narrower, and the first arm-plates much shorter.

Geological formation and locality. In the Warsaw limestone : Warsaw, Illinois.

Poteriocrinus cultidactylus (n. s.).

Body elongato-turbinate and slightly expanding at the base of the arms, which are regularly bifurcating and but slightly spreading. Basal and subradial plates unknown. Radial series consisting of three plates in each ray, the upper one of which is a bifurcating plate. First radial plates pentagonal, besides the truncated angles. Second radials about as long as wide, quadrangular with truncated angles. Third radials pentagonal, obtusely wedgeform above, and supporting on each side a series of eight arm-plates, the upper one of which is a bifurcating plate : above this, on the outer side, there is a bifurcation on the twelfth to the sixteenth plate, while the division on the other side remains simple as far as can be traced in the specimens. This character applies to all except the anterior ray, where the bifurcation takes place on the twentieth plate above the first division.

The anal series consists of a number of small, usually hexagonal plates.

The plates of the arms are round upon the exterior face, a little wider on one side than the other in alternating order. The surface is finely granulose, without peculiar markings.

The specimen is imperfect at the base; preserving the radial series and the arms to the extent of an inch and three-fourths, together with the greater portion of the anal area.

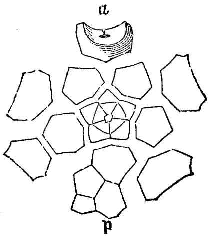
Geological formation and locality. From the base of the Burlington limestone near Hamburgh, Illinois.

Poteriocrinus aqualis (n. s.).

Calyx broad, cupshaped, abruptly spreading from the lower margins of the radial plates, and contracted on the anal area. Basal plates small, slightly curving upwards from the circumference of the column, their lateral angles extending but little beyond the column. Subradials of medium size, convex in the centres, four of them hexagonal and one heptagonal; length and breadth equal. First radial plates large, four of them as wide again as high, hexagonal; the articulating scar occupying about three-fourths of the width of the plate; the upper lateral angles abruptly bent inwards, forming deep grooves along the suture-lines. First anal plate heptagonal, as large or larger than a radial plate : second one smaller, pentagonal; the two succeeding ones unequal, the larger one being heptagonal and the smaller one pentagonal.

Column large, pentagonal near the body : central perforation small, pentangular.

Summit and arms unknown. Plates without distinct surface markings.



Poteriocrinus aqualis.

This species may be distinguished from any other of this genus yet described from these rocks, by the abrupt spreading of the radial plates, as well as by the broad cupform calyx and smooth surface of the plates. The articulating scar is much wider in proportion, than in any other species known in the same geological position.

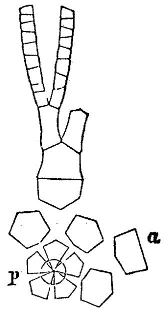
Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Poteriocrinus keokuk (n. s.).

Body narrowly and regularly turbinate from its junction with the column to the top of the first radial plates. Basal plates of medium size, pentagonal, length and breadth about equal, very obtusely wedgeformed above. Subradials comparatively large, three of them hexagonal; the form of those adjoining the anal area not determined. First radials pentagonal, once and a half as wide as high; having one of the upper lateral angles very slightly truncated by the opposite angle of the second radial plate of the adjacent ray. Second radials proportionally large, wider than high, greatest width at the base, very slightly inflected at the sides and obtusely wedgeformed above; sustaining upon each side an elongated plate, which forms the bases of the arms: this plate, in one of the antero-lateral rays, is twice as long as wide, wedgeform above, each plate giving origin to two simple arms, making four to each ray. Arm-plates much longer than wide below, becoming gradually shorter above, and all longer on one side than on the other. Anal plates unknown.

Column round near the body, rapidly tapering, composed of alternating thick and thinner joints.

This species differs from all others yet described, in the manner of bifurcation of the arms, no other species bifurcating on the first plates above the radial series; and also in the form and proportional size of the plates.



Poteriocrinus keokuk.

Geological formation and locality. In the Keokuk limestone: Keokuk, Iowa.

Scaphiocrinus divaricatus (n. s.).

Body shallow cupform; base small, nearly flat or slightly concave: subradial plates wider than long. First radial plates pentagonal, twice as wide as long, with the upper lateral angles sometimes slightly truncated: second radials subtriangular with the apex slightly truncated, the arms originating from the sloping sides and widely divaricating. Arms bifurcating on the sixth plate above the base, the branches widely diverging, and the wedgeform plate truncate at its upper extremity, separating the plates of the two branches at their origin: plates of the arms unequally quadrangular, with tentacula originating from the upper part of the wider sides; tentacula at base composed of short strong joints.

Column unknown. Surface finely granulose.

Geological formation and locality. In the Warsaw limestone: Warsaw, Illinois.

Forbesiocrinus agassizi.

Forbesiocrinus agassizi: cited and illustrated in Geol. Report of Iowa, Vol. i, Part ii, pp. 630 & 631.

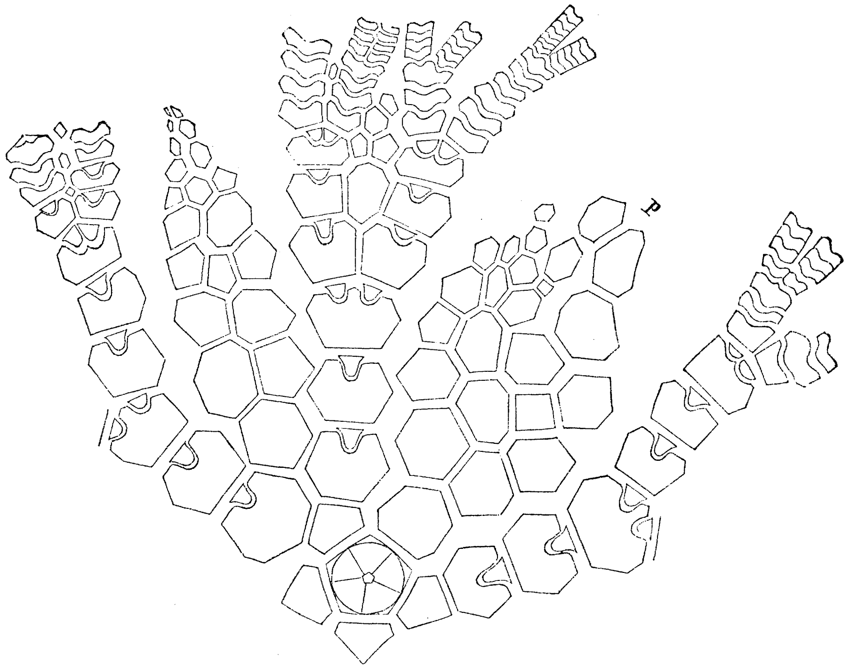
Body robust, subspherical, spreading from the column, and attaining its greatest diameter just above the third radials; beyond which, it gradually contracts to the base of the free arms. Basal plates wide and short, forming a narrow ring around the top of the column. Subradials of medium size, pentagonal. First, second and third radials of nearly equal size, and varying somewhat in the different rays; the first ones six- or seven-sided, the second hexagonal, and the third hexagonal and heptagonal, broadly wedgeform above, and supporting on each sloping face a series of three supraradial plates varying in size and form, the upper one of which is a bifurcating plate, and sustains on its sloping faces a series of second supraradials varying from three to seven in number below the next bifurcation. The last described plates are short and broad, curving downwards in the middle. Above the second bifurcation the arms become free at the outer margins of each ray; while the inner divisions still remain attached to the body as far as the next bifurcation, where they become free. Interradial series composed of fifteen to twenty or twenty-five plates, according to the size of the individual : the first one hexagonal; the second range of two plates, nearly as large as the first; those above being somewhat irregularly placed in ranges of two, three or four, and are of irregular forms.

The first anal plate is heptagonal, resting on the basal plates between the subradial and first radial plates of the adjacent rays, and supporting two large plates in the second range, which are hexagonal, and three or four in the next range; beyond which they are very irregular in size, form and arrangement, diminishing towards the upper part of the area, the entire number being from thirty to forty.

The free portions of the arms are composed of short wide plates, the entire number at their extremities being unknown. A single ray above the first bifurcation, after becoming free, has sixteen arms; and most of these are seen to bifurcate once, and several of them twice, before they terminate, their imperfection preventing the determination of the entire number, which was apparently sixty-four in this ray, and, if all the rays were equal, which is probable, would give the enormous number of 320 arms. A specimen of less size shows, in a part of the rays, that there were between 150 and 200 free arms at their extremities.

The column is round, rapidly tapering below the summit, and composed of extremely thin plates.

This remarkable form is so distinct from any other of the genus, that it requires little comparison with any described species. The robust body, with strong protuberant plates which are plane or nearly flat along their margins, is a very peculiar and characteristic feature*.



FORBESIOCRINUS AGASSIZI.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Forbesiocrinus ramulosus (n. s.).

BODY small, broadly subturbinate, with strong prominent rays. Basal plates not projecting beyond the periphery of the column. Subradials small, four of them pentagonal and one hexagonal; lower margins concave, to fit the circular edge of the basal plates. First radial plates proportionally large, once and a half as wide as long, heptagonal, the upper angles being slightly truncated by the interradials. Second and third radials hexagonal, twice as wide as long. Fourth radials heptagonal, a little wider than the third. Plates of the second division four, those of the third division five, of the fourth division five or six; above which the arms appear to be simple, giving sixteen arms to those rays where they can be determined, the specimen being partially imbedded in stone.

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* For observations on the Genus FORBESIOCRINUS, and the mode of articulation of the plates, see Geological Report of Iowa, Vol. i, Part ii, pp. 228 - 231.

The patelloid plates are recognized by a shallow sinus in the radial series; but in the second and third divisions they are very distinct, while in the upper part of the arms they are long and well formed. Interradial and anal plates undetermined.

Column large near the body, and rapidly tapering; composed, near the body, of very thin joints, which gradually increase in thickness as they decrease in diameter.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Forbesiocrinus cestriensis (n. s.).

Body irregularly subglobose, with the interradial and anal areas depressed. Basal and subradial plates unknown (covered by adhering stone). Radial series consisting of four plates; the first, second and third hexagonal, twice as wide as high: the fourth radial is five-sided, wider than high, supporting on each upper sloping face a supraradial series of two or three plates each, the lower ones hexagonal, and the upper or bifurcating plate is five- or six-sided, supporting on each sloping side supraradials of the second order; above which the arms become free, bifurcating on the second or third plate of the second supraradial series, and again on the fourth, fifth or sixth plate above; giving, as far as observed, eight divisions to each ray, which are probably again subdivided. Anal area consisting of fifteen or twenty plates, ten of which are much larger than the others. The anal plates are strong, rounded on the back, the length and breadth being nearly equal.

Surface smooth. Column consisting of alternating thinner and thicker joints.

This species is smaller than any other observed, except the *F. ramulosus* of the Burlington limestone. The plates do not show the peculiar indentation of the upper edges, or the little patelloid plate on the lower margins. It differs from *F. ramulosus* in the less angular form of body, caused by a lesser depression of the interradial and anal areas : the body is higher in proportion to its width, the arm-plates are longer, and the divisions of the arms more divergent than in that species.

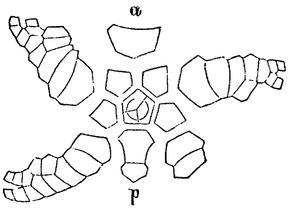
Geological formation and locality. In the Kaskaskia limestone : Pope county, Illinois.

Mespilocrinus konincki (n. s.).

The form of the body is globular; the basal plates forming a low rim above the top of the column, very unequal in size; the large ones pentangular, and the small one quadrangular. Subradials, four of them small and pentagonal in appearance, from the straightness of the lower edges of those situated above the suture lines of the basal plates; the fifth is large, hexagonal, nearly double the size of the others. First radial plates large, pentagonal, much wider above than below. Second radials as wide as the first, very short on the inner side, pentagonal. Third radials smaller than the second, hexagonal, the inner side almost pointed Arms bifurcating on the second supraradial plate, on the outer side; those of the inner side covered by the adjacent arm, and not visible. Anal plates larger than the subradials, heptagonal.

Surface smooth. Column near the body composed of thin plates, gradually increasing in thickness as they recede, until at the distance of an inch they are nearly globular.

This small species of Mespilocrinus bears considerable resemblance to *M. forbesianus* of De Koninck and Lehon, but differs much in the form and proportions of the plates, as may be seen by a comparison of the diagram with their figures (Recherches sur les crinoides, etc. pa. 111, pl. 2, f. 1).



Mespilocrinus konincki.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

GENUS TREMATOCRINUS (HALL).

GENERIC FORMULA.

Basal plates, 5.
Subradial plates, 5.
Radial plates, 3 × 5.
Supraradials, or
  Radials of the second order, 3 or 4 × 10.
Anal plates, 12 to 17 or more.
Interradials, 12 to 15 or more.
Arms five, bifurcating.
Pores or ambulacral openings, 10.

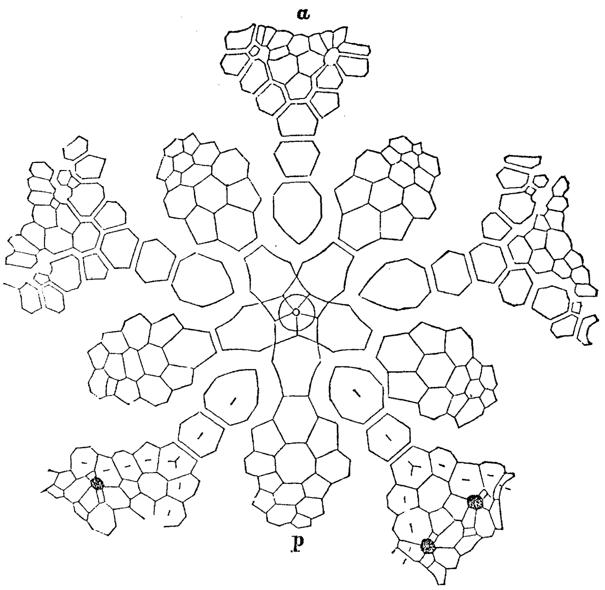


DIAGRAM OF TREMATOCRINUS.

BASAL plates five, small, pentangular and forming a five-rayed star. Subradial plates five, heptagonal (counting the the lower margin as two sides), regularly alternating with the basal plates, truncated above by the first plate of the anal and interradial series. Radial plates in five series of three each, the lower ones heptagonal and the second ones hexagonal; the third radials hexagonal or heptagonal.

The third radial plates, on their upper sloping sides, support a series of supraradial or secondary plates consisting usually of three : these divisions of the ray diverge ; and the last plate of the supraradial series, in the divisions of the adjacent rays, unite by their lateral faces over the centre of the interradial and anal areas, where they support a pair of brachial plates. The anal series consists of twelve to seventeen plates (and may be more or less in different species); the first one rests upon the truncated upper face of the subradial plate, and each successive range consists of smaller plates.

The interradial resembles the anal area; being a little smaller, and usually with fewer plates. Both the anal and interradial areas are separated from the summit of the crinoid by the arching divisions of the ray, allowing the last supraradial plates to unite just below the margin of the dome. Between the divisions of the ray, and bounded on two sides by the supraradial plates and on the upper side by the plates of the dome, is a subtriangular space which is perforated by two oval or polygonal openings, each of which is margined on its lower and outer sides by the second and third supraradial plates, and on the inner and upper sides by the plates of the area. This area is composed of from nine to twelve plates, varying in different species ; those bordering the foramen are arranged in the form of an arch, the lower end of which rests upon the first plate of the series, the upper end of the arch resting against the brachial plates. This space I have termed the foraminiferous area.

Summit composed of polygonal nodose plates, apparently without aperture or proboscis. Arms at the base, composed of a double series of semielliptical brachial plates interlocking with each other, and each series perforated. These parts, bifurcating near the body, give origin to round arms, composed of circular plates having a central perforation.

This crinoid has many analogies with the Genus RHODOCRINUS, and the arrangement of the plates of the body is essentially the same; but its great peculiarities of structure in the upper part of the body preclude its association with the species of that genus, in any strict classification. In three or four species examined, the base is deeply cancave; the subradial and first radial plates are strongly nodose, or produced into sharp mucronate spines which extend obliquely downwards, so that the fossil, when placed upon its base, rests upon the nodes or spines of the subradial or first radial plates. In this respect it resembles the base of the ACANTHOCRINUS of RŒMER*, but differs very essentially from that genus in the upper part of the body and arms.

In the radial, interradial and anal series, there is no important departure from RHODOCRINUS; but in the divisions of the ray we observe a distinctive feature, and the deviation from RHODOCRINUS is still farther marked where the simple supraradial series diverges, and, arching over the interradial series, unites by its last plates with the corresponding division of the adjacent ray; thus enclosing the interradial area, and separating it from the plates of the summit. From these two third supraradial plates, thus united, proceed two arm-plates of peculiar character; being semielliptical in form, their straight sides in contact, and the longest diameter of the ellipse transverse to the axis of the crinoid. Each of these plates is perforated nearer to its straight side; and several of these plates conjoined make a short strong arm, which projects almost horizontally for a short distance, and is then subdivided, the divisions being composed of circular plates with a central perforation, and the arm not distinguishable from a portion of a crinoid column. The plates of the arm may be smooth or spinose exteriorly. I have not observed this form or character of arm in any other crinoid.

The area between the divisions of the ray, as already described, is a peculiar and distinctive feature, separating it clearly from any true RHODOCRINUS. The foramina or ambulacral openings differ from any thing observed in other crinoids, and, so far as we can now determine, have not been connected with solid arm-plates or other strong covering; though it is difficult to conceive of any other arrangement, with our present knowledge of these fossils. The plate on the lower side, and sometimes some of the others, show a peculiarly depressed surface near the foramen; but no vestige of articulating plates has been seen in the specimens examined, and the aperture appears as if intended for the protrusion of fleshy arms or tentacles.

The *Rhodocrinus bursa* of PHILLIPS possesses similar openings, which are treated by Mr. BILLINGS† as ambulacral openings. In the figure cited, these foramina are placed in pairs near the summit of the ray; and the solid arm-bases are represented as directly above the radial plates, as shown in the accompanying figure of one of the rays of that species; while in our fossil they are uniformly above the interradial and anal areas, and, instead of being supported by the supraradials of a single ray,

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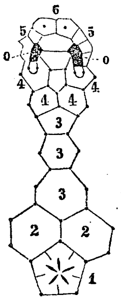
* I have seen only the figure of ACANTHOCRINUS given by PICTET in his valuable work, "Traité de Paléontologie," Plate C, fig. 11, which shows a very different structure in the upper part of the body from our fossil, and particularly in the arms and arm-bases. It seems to me probable, however, that there is some error in the drawing of the figure given by PICTET; for with all deference to the authority for the genus, I feel constrained to express a doubt whether any crinoid has ever such an arrangement and relation of the arm-plates to those of the radial series as shown in the figure cited.

† Figures and Descriptions of Canadian organic remains, Decade III, p. 26.



Acanthocrinus.

they are supported by the union of the plates of the half of two adjacent rays throughout the whole body. It is scarcely possible, from the structure of the appendages here taking the place of arms, that they could have performed the functions of ordinary arms of other crinoidea which have a grooved inner face and tentacles of the same character, which were occupied by the soft parts of the animal.

It is possible, however, that these cylindrical arms may have assumed the ordinary character of crinoidean arms towards their outer extremities, and may have been furnished with tentacula. This feature, however, if hereafter proved to exist, does not affect the conclusions upon which the genus is founded.

Trematocrinus typus (n. s.).

Body marsupiform, concave at base, somewhat inflated below the middle and contracted below the bases of the arms, spreading above, and forming together with the arm-bases a projecting rim like the lip of an urn : summit flat, or very slightly convex. Base pentagonal, composed of five small pentagonal plates which are slightly excavated in the centre for the reception of the column. Subradials comparatively large, hexagonal in form, wider than long, largely truncated above by the first interradial and anal plates. First radials large, but smaller than the subradials, pointed below where they fit into the receding angles of the adjacent subradials. Second radials small, less than half the size of the first, somewhat regularly hexagonal. Third radials larger than the second, heptagonal, obtusely wedgeform above, and supporting on each of their sloping faces a series of three supraradial plates, which, diverging from the third radials, unite over the centres of the interradial and anal areas with the corresponding plates of the adjacent rays, and form by their union the bases of the arms. The second of these plates is a very little excavated on the upper side, and forms the base of the foramen, while the upper of the three forms one of its sides in a like manner.

The interradial series consists (as far as ascertained) of fourteen plates each; the first one, which is largest, is hexagonal and intermediate in size between the first and second radials, resting upon the top of the subradials and between the first radials, supporting upon its upper faces three smaller plates in the second range and four in the third, three in the fourth, two in the fifth, and one above completing the series.

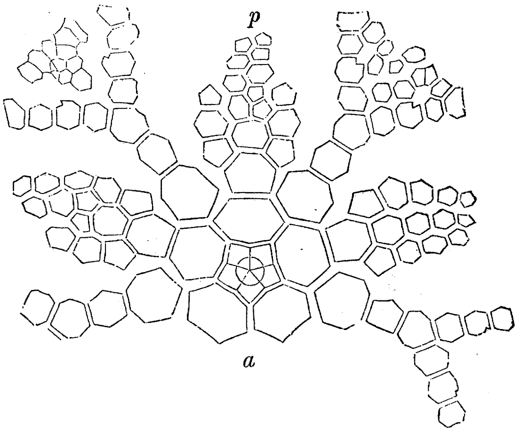
The anal series consists of seventeen plates; the first one large, hexagonal, sustaining three smaller plates in the second range, the middle one of which is heptagonal, the others pentagonal : the third range consists of four plates; the remaining plates are irregularly placed above.

The foraminiferous areas are subtriangular, composed of ten or eleven small polygonal plates; the first one, which rests upon the inner angles of the first supraradials, is hexagonal, obtusely wedgeform above : the remaining plates are arranged in the form of segments of a circle, or the half of an arch placed back to back, the lower ends of which rest upon the first single plate, while the upper ends rest against the bases of the arms. There are sometimes one or two small intercalated plates in the centre between the arches. The foramina are variable in form and size, mostly elongate-hexagonal : the longest are nearly a line in length, formed by the inner ends of the plates of the arches, together with those of the second and third supraradial plates.

The dome is composed of small nodose plates; and near the origin of each set of arms there is a subrhomboidal depression, extending about half the distance between the arm and the centre of the dome.

The arm-bases are composed, in each set, of a single pair of semielliptical plates, which unite by their straight sides and form an elliptical arm : each of these has a small round perforation passing through the substance of the plate, which is analogous to the groove on the inner side of the arms of other crinoidea. These plates are interlocked at their adjacent margins, as the plates in the arms of other crinoids, to the extent of four pairs of plates, when they bifurcate, and the arms are continued in the form of simple round columns composed of thin circular joints perforated in the centre. We have, in these arms, so far as known, no evidence whatever of tentacula.

Surface of the plates of body and dome all more or less nodose; those of the subradial and first radial plates produced into long sharp spines, which are directed obliquely downwards.



Trematocrinus typus.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Trematocrinus tuberculosus (n. s.).

Body broadly calyculate : base concave ; sides nearly straight to the top of the third radial plates. Basal plates forming a pentagonal disc at the bottom of the cavity. Subradial plates heptagonal; the upper half going to form part of the outer wall of the body, and the lower half forming the walls of the cavity; the central portion of the plates produced into a strong tuberculiform node, thus surrounding the depression with five strong tubercles.

First radial plates heptagonal, a little smaller than the subradials, strongly tuberculiform in the middle. Second radials less than half as large as the first radials, hexagonal, longer than wide. Third radials convex in the middle, heptagonal, as large or larger than the second; the two upper sloping faces supporting supraradial plates, the second of which forms the base of the foramen.

First interradial plate large, subtuberculiform, less in size than the first radial, and succeeded by three ranges of three plates each, above which the structure is undetermined.

Dome and arms unknown.

This species has a proportionally broader body than *T. typus;* the plates are larger and strongly tuberculous, but not spiniform. From the *T. papillatus* it differs in the strong rounded tuberculiform plates; and from the *T. robustus* of the Keokuk limestone, in its conspicuously tuberculiform subradials, which, in that one, are almost restricted within the basal cavity.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Trematocrinus papillatus (n. s.).

Body robust, spreading above : the subradials, first and second radials and interradials large, abruptly convex; the upper ones produced into a papilliform node in the middle, and the subradials into short rounded spines.

The plates of this species are larger than in the two preceding forms; the spines are never produced as in *T. typus,* and the central apicial node or subspine gives a distinctive feature when compared with *T. tuberculatus.*

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Trematocrinus robustus (n. s.).

Body below the arms somewhat regularly turbinate, broadly truncate below, with the base deeply concave; the basal and subradial plates deeply impressed, forming a large cavity, the sides of which overhang the top of the column. Basal plates forming a disc in the bottom of the cavity, their form not determined. Subradials heptagonal, and largely truncated at their outer ends by the first interradial and anal plates.

The first radial plates are situated at the base of the cup, and aid in forming the outer walls of the body a little more than those of the cavity: they are all equal in size and heptagonal in form, pointed below, and fitting into the receding angles of the subradial plates. Second radials much smaller than the first, hexagonal, height and width generally about equal. Third radials smaller than the second, hexagonal, somewhat largely truncated above by the first plate of the foraminiferous area, and sustaining upon each of their oblique sides two supraradial plates, the one above the other, the uppermost one being excavated at the top for the reception of the foramen. Above these, and resting upon the outer angles of the upper one, there are two other plates on each side, situated one above the other as in the former case, and united by their lateral faces with the corresponding plates of the adjacent ray, completely enclosing the anal and interradial areas, and forming by their union the bases of the arms.

The anal and interradial areas are each composed of thirteen plates, the only difference between them consisting in those of the anal series being a little larger and somewhat differently arranged from those of the interradials. The first plate of these series is hexagonal, slightly elongated, resting upon the upper or outer face of the subradial and between the adjacent first radial plates, sustaining upon their upper faces three smaller plates, the central one in the interradial areas hexagonal and the others pentagonal : the third, fourth and fifth ranges consist also of three plates each, arranged in arches one above the other, and gradually decreasing in size as they approach the upper extremity of the area. In the anal series, the central plate of the second range is nearly as large as the first one, octagonal in form, and is arched above by five plates instead of three, as in the interradial series, while the remaining four plates are irregularly arranged above.

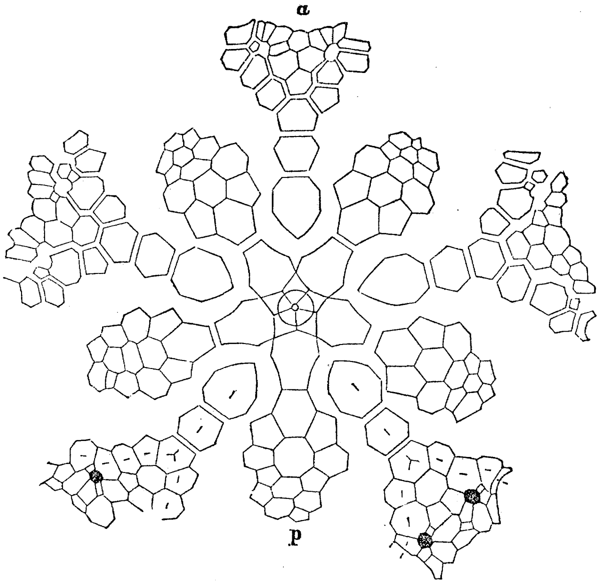
The foraminiferous area consists of from nine to twelve plates; the first one of which, resting upon the truncated top of the third radial, is largest, heptagonal, wider than high, very obtusely wedgeform above; each of the sloping sides forming the base of a series of plates arranged in the form of half an arch, the other side being completed by plates at the base of the arms. The plates forming these arches, of which there are three on each side, are narrower and depressed on their inner ends, and, together with the second supraradial, form the boundary of the perforation. Perforations subcircular or polygonal, little more than half a line in diameter, and are surrounded by a depressed area of about two lines in diameter.

The summit of the specimen is depressed convex, composed of medium-sized polygonal nodose plates, some of which are so arranged as to form several series of rhombs; one series of which occupy the spaces between the arm-bases, there being one rhomb between each set of arms, the longest diameter being from one arm to the next : those of another series are placed above the arms, and directed from the arm bases towards the middle of the dome. There is also the appearance of another series surrounding the centre of the dome, but the specimen is too imperfect to admit of their satisfactory determination. The centres of these rhombs are depressed, and the plates are but slightly convex; while the plates of the lines limiting the rhombs are elevated into nodose ridges, and form a conspicuous feature in the fossil.

The arm-bases are composed of several small plates; but they are all broken, so that the form of the true arm-plates cannot be determined.

Surface of the plates of the body slightly convex; those of the rays most conspicuous, while those of the first radials are produced into pointed nodes having the points directed downwards below the base of the cup.

This species differs from the others here described, in the more robust and spreading character of the body. The subradial plates are mostly embraced within the basal depression, their summits reaching only to its margin, while the first radials are produced into obtusely pointed nodes which occupy a position relatively to the basal depression that the subradials do in the other species.



TREMATOCRINUS ROBUSTUS.

Geological formation and locality. In the Keokuk limestone at Keokuk.

Rhodocrinus varsoviensis (n. s.).

Body broad urnshaped : basal plates small; subradials larger than the first radial plates; radial and interradial plates small : arms, apparently, two from each ray.

Column near the body composed of alternating thicker and thinner joints, and at a greater distance of equal joints with rounded edges, while still lower it is composed of alternating joints.

The only specimen I have seen is much crushed, and the plates so distorted as to render it difficult to determine the structure. There still remains, attached to the body, more than four inches of the column.

Geological formation and locality. In the Warsaw limestone : Warsaw, Illinois.

Graphiocrinus dactylus (n. s.).

Basal plates? Subradials elongated, twice as long as wide. First radial plates pentagonal in general form, one of the upper lateral angles being slightly truncated by the second radial of the adjacent ray; width equal to once and a half the height. Second radials pentagonal with one of the lower angles slightly truncated, wedgeform above, and supporting two arms, which are composed of short broad plates having one side wider than the other, approaching to wedgeform.

Surface granulose.

I refer this species to the Genus Graphiocrinus of De Koninck and Le Hon*. In the specimen here described, there are no basal plates proper visible, and the subradials appear to rest their bases against the column. In the divisions above, there is an entire correspondence with Graphiocrinus, except that the plates of the arms are in some degree wedgeform, and the suture-lines consequently not parallel.

Geological formation and locality. In the St. Louis limestone, near St. Louis, Missouri.

* I am disposed to regard the basal plates, as shown by these authors, to be the subradials; while there are a set of small basal plates within the area of the column.

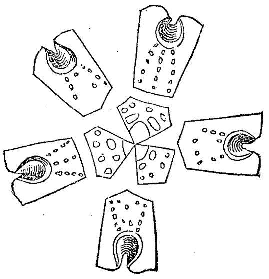
Platycrinus subspinulosus (n. s.).

Calyx turbinate, rising gradually from the junction of the column to the upper edge of the radial plates. Basal plates nearly equal in size, deeply indented at the suture lines. Radial plates elongate, hexagonal; height once and a half the width, gradually increasing in width from below upwards, deeply and acutely notched above : articulating scar small, nearly circular, situated entirely below the top of the plate, and greatly protruding at the lower margin, which feature gives to the radial plate extreme convexity.

Surface ornaments consisting of short slender spines on the radial plates, while those of the basal plates are thickened so as to form small nodes : these last are arranged in lines running around the base of the cup, the first just above the junction of the column, the second near the upper line of the basal plates. Those of the radial plates commence from the lower side of the protruding scar, and pass downwards, the outer ones to the lower lateral angles of the plates, and the third or central one to the middle of the lower margin; or the nodes are sometimes scattered irregularly over the space between the outer lines. The spaces between the articulating scar and the edge of the plates are smooth.

Summit and arms unknown. Column of medium size, elliptical.

The form of the cup of this crinoid is somewhat similar to the general form in the Genus Dichocrinus, but the base is distinctly divisible, into three parts. This form, together with the peculiar markings, will serve to distinguish it from any other species of Platycrinus known to me in these rocks.


Platycrinus subspinulosus.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Platycrinus pumilus (n. s.).

Body small, spreading; base discoid. Radial plates nearly one-fourth wider than long, broadly concave on the upper margin: brachial plates triangular, partially filling the concavity: arms bifurcating on the first brachial and also upon the second plate above, the inner divisions also dichotomizing. Arms above composed of a double series of strong wedgeform plates, which are slightly concave on their outer edges, and furnished with strong tentacula.

Column, near the body, composed of thin joints. Surface granulate.

This small species bears some resemblance to one or two species in the Kaskaskia limestone, but is quite different from either. One of the rays supports nine arms, while the adjacent ray shows but six: the latter, however, is imperfect.

Geological formation and locality. In the Warsaw limestone: Warsaw, Illinois.

Platycrinus georgii (n. s.).

Body strong: base short subdiscoid, the plates thickened; articulating area large. Basal plates wider than long, broadly and deeply concave on the upper margin; the concavity, including the third plate of the brachial series, with the upper adjacent angles distinctly truncated by a small interradial plate. First brachial plate small, triangular, occupying a part of the lower side of the concavity of the radial plate; the arms bifurcating on its upper sloping edges, and again on the second plate above, each of the inner divisions again bifurcating once or twice; composed of a double series of plates, which are about half as long as wide: tentacula strong, occupying at their base nearly the whole length of the arm-plates.

Column strong, tortuous, elliptical in section.

This is a well-marked and very distinct species, which, in its large articulating basal surface, tortuous column, and strong somewhat rigid arms, is readily distinguished.

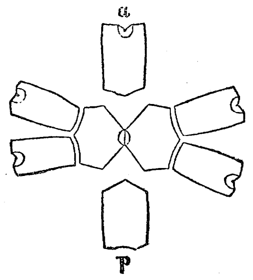
Geological formation and locality. In the Warsaw limestone : Warsaw, Illinois.

Dichocrinus lævis (n. s.).

Calyx goblet-shaped. Basal plates very slightly projecting at their lower margin, and forming two-fifths of the entire height of the calyx. Radial plates twice as high as wide : articulating scar very small, occupying about one-third the width of the plate, the greatest width of the plate being just below the base of the articular scar. Anal plate equal in size to the radial plates, heptagonal in form.

Surface of plates smooth. Column small, elliptical at the junction with the body. Summit and arms unknown.

This species of Dichocrinus is sufficiently distinct from any other known to me in these rocks, to be at once recognized by the description and diagram. It bears some resemblance to *D. radiatus* of DeKoninck and Lehon (Recherches sur les Crinoïdes du Terrain carbonifère, Pl. iv, f. 8); but the base of our species is much less protruding, the body not so much contracted at the upper portion of the radial plates, and the diameter much less in proportion to the height.



Dichocrinus lævis.

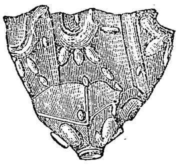
Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Dichocrinus lachrymosus (n. s.).

Body turbinate, higher than wide. Basal plates forming nearly half the entire height. Radial plates as wide or wider than high : articulating scar long and narrow, extending downwards from the top of the plate more than one-third its entire length, and bordered by a subnodose ridge, from the lower margin of which commence three lines of nodes on those plates which rest above the sutures of the basal plates, and two on each of the others; the outside rows passing to the outer lower angles of the plate, while the inner ones pass to the middle of the lower margin. Each of the basal plates are furnished with three large nodes arranged around the articular facet of the column, and having smaller nodes between them : these large nodes are the commencement of other lines which pass upwards, and meet those of the radial plates. The nodes are of an elongated ovate form, and the surface of attachment is smaller than the greatest diameter, like a succession of beads placed upon the surface, large at one end of the line, and gradually decreasing in size as they approach the other.

Minute surface granulose, and in some parts striato-granulose. Column small, round, composed near the body of thin plates.

The peculiar surface marking of this species is a character, by which it may be readily distinguished from any known form.



Dichocrinus Lachrymosus.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Dichocrinus dichotomus (n. s.).

Body broad, somewhat shallow cupform, the basal plates being a little more than one-third of the height. Radial plates wider than long, slightly thickened in the centre below the articulating scar : first brachial plates extremely short, narrow, quadrangular, occupying scarcely more than one-fifth the width of the radial plate at the top ; second brachial plate pentagonal, the arms bifurcating from its upper sloping sides, and dichotomizing twice or oftener beyond this point. Arms, in their lower part and beyond the last bifurcation, composed of a single series of quadrangular plates, which are narrower on one side, and above the last bifurcation gradually become more unequal, till they consist of a double series of alternating pentagonal plates united at their wedgeform margins.

Surface of plates punctate or marked by slight rounded depressions, which are separated by narrow elevated lines.

This species is peculiar in its surface markings, and in its very small brachial plates scarcely indenting the upper margin of the radial plates, as well as its slender arms.

Geological formation and locality. In the Warsaw limestone : Warsaw, Illinois.

Pentremites longicostalis (n. s.).

I indicate this species here, from its interest as adding another very distinct form of this genus from the Warsaw limestone. The specimens I have seen are fragments of some extremely elongated and very narrow plates, the length of the longest fragment being more than three-fourths of an inch. The pseudambulacral area occupies about two-thirds of the entire length of the plate, and is very narrow : the poral plates are simple, very strong, and obliquely arranged, there being about seven to eight in the space of one-eighth of an inch. The great length of the radial plates, the linear pseudambulacral areas and strong poral plates, are distinguishing features.

Geological formation and locality. In the Warsaw limestone : Warsaw, Illinois.

The two following species are introduced in this place, although the descriptions were written at a much later date than the preceding ones, and after the printing was nearly completed, so that they could not be inserted in their proper places among the others.

Actinocrinus spino-tentaculus (n. s.).

CALYX turbinate, and somewhat spreading near the bases of the arms : base truncate. Basal plates short. First radial plates large, hexagonal and heptagonal, higher than wide. Second radials less than half as large as the first; those of the postero-lateral rays being pentangular, having two faces on the side of the interradial series and one on the side of the anal series, the width of the plate being greater than the height. Third radial plates larger than the second, heptagonal and hexagonal, wider than high, supporting upon their upper sloping sides a pair of large irregularly heptagonal supraradial plates, which in turn sustain upon their outer sloping faces a medium-sized brachial plate which gives origin to a single arm, and upon their inner faces a supraradial plate of smaller size, which supports in like manner brachial plates with a single arm on one side and a supraradial plate with two arms on the other side; giving eight arms to each ray, the position of the single arm being on the side opposite to that of the first set. Between the first supraradial plates, and resting upon their inner edges, there is a single inter-supraradial plate of medium size, which entirely separates the succeeding plates of the two principal divisions of the ray.

First interradial plate much smaller than the first radial, hexagonal, supporting two smaller plates in the second range, one hexagonal and the other heptagonal, with two or three smaller irregularly formed plates above in one or two ranges. Anal series (in the specimen described) consisting of ten plates in five ranges : the first, of one hexagonal plate little smaller than a first radial plate; the second, of two smaller plates, one of which is seven- and the other eight-sided; the third range consists of four small polygonal plates; the fourth, of two, and the fifth of one narrow elongated plate which extends up between the plates of the adjacent rays.

Surface of plates traversed by elevated ridges; those of the basal and lower side of the first radial plates being compound, while those of the other plates are simple, or have one ridge to each principal face, which, meeting in the centre of the plate, form a more or less elevated spiniform tubercle.

Arms simple from their origin, spreading horizontally for a short distance, and then bending abruptly upwards; composed of a double series of short plates, which are obtusely wedgeform at their interlocking edges. Tentacula composed of rather long slender joints, each of which is furnished near the middle of its outer surface with a toothlike spine which is curved abruptly upwards; those near the arms being short and obtuse, and gradually increasing in length as they recede from the arm, until at the distance of half an inch the spine is as long as the joint itself, and standing nearly at right angles to the plane of its surface. The tentacula, on their inner surfaces, are deeply grooved like those of most species of ACTINOCRINUS; but the grooves are closed by a double series of minute plates, their interlocking edges forming a line along the middle, which is entirely invisible to the naked eye, but, when seen through a lens of considerable power, presents very much the same appearance as the back of the arms, except that the surface is concave instead of convex. The centre of each plate forms a ridge running from the side of the joint to near the middle, where they alternate with those of the other side.

Column round, large, composed of alternate thick and thinner joints, which are beautifully beaded near their articulating surfaces, aud thinning to the margins.

This species has its greatest affinities with *Actinocrinus cœlatus*, *A. multibrachiatus* and *A. fosteri*, but differs from all except *A. cœlatus* in the greater number of arms and other important points of structure; while from that species it differs in the greater proportional height of the plates of the body, the greater number and different arrangement of the anal plates, in the pattern of the surface markings, and in not having the bases of the arms elevated into high ridges. The arms of that species do not spread horizontally, as in this; owing to the greater proportional width of that one, allowing them more room. This feature causes the arms in *A. spinotentaculus* to be very slender near the base, and they only attain their full width after they assume their vertical direction.

I am indebted to Mr. FRIEDRICH LEUNIG of Burlington, Iowa, for the use of this very interesting species of ACTINOCRINUS. The original has been taken by him to Germany, but I have had drawings prepared for its future illustration.

Geological formation and locality. In the Burlington limestone : Burlington, Iowa.

Forbesiocrinus saffordi (n. s.).

BODY extremely ventricose, depressed spheroidal, curving upwards from the summit of the radial series, and abruptly contracted at the base of the arms; somewhat pentalobate from the middle downwards, owing to the prominence of the radial series; the lobes becoming double above, from the division of the rays and the prominence of the supraradial series. Base short, abruptly truncate : basal plates not extending beyond the circumference of the column, but appearing as a tripetaloid joint at the summit. Subradial plates short, pentagonal; the one on the anal side being hexagonal.

Radial series consisting of four plates, which increase in size from the bottom; the first ones heptagonal in the anterior and antero-lateral rays, while in the postero-lateral rays they are hexagonal. Second and third radials hexagonal; the fourth, heptagonal and obtusely wedgeform above, supporting on each of its sloping sides three or four supraradial plates, one above the other; the first being larger than the others, the third one very obtusely wedgeform, and supporting supraradials of the second order to the number of four, above which the arms appear to have been free.

Interradial series consisting of at least thirty plates, in ranges of one, two, three and four plates from the base, diminishing above, and the upper ones irregularly disposed. The first plate of the anal series rests upon the truncated subradial plate; the succeeding ones arranged in a series of arches above, the individual plates being larger than those of the interradial series. The inter-supraradial series consists of at least eight or nine plates in ranges of one, two and two; the upper ones being irregular.

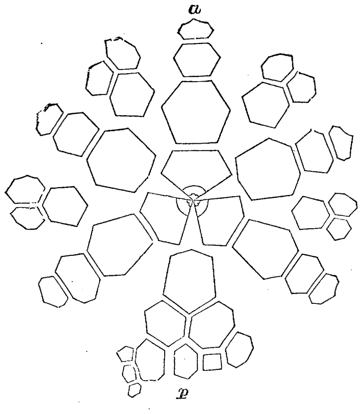
Surface of the radial and supraradial plates extremely convex; that of the interradial, inter-supraradial and anal series flat or concave, conforming to the general concavity of these areas. All the plates of the body, above the last supraradial plate, are moderately convex. Entire surface finely and beautifully granulose. The patelloid plates have not been observed below the summit of the first supraradial series.

The specimen has a transverse diameter, through the supraradial series, of two and a half inches, and a height of two and a half to the base of the arms.

This species is larger than any other of the genus yet observed; exceeding in size the *F. agassizi*, and, in perfect specimens, would equal or exceed in beauty and magnificence any of our carboniferous crinoidea.

I am indebted to Prof. SAFFORD of Tennessee for this beautiful species, and take pleasure in dedicating it to a geologist who has labored so long and faithfully in this field of science.

Geological formation and locality. In limestone of the age of the Keokuk limestone, at White-Creek springs, Tennessee.



Actinocrinus multiradiatus (SHUMARD).

CORRECTION.—The *Forbesiocrinus whitfieldi* of the Iowa Geol. Report, p. 632, is referred by error to the Keokuk limestone : the specimen is from the Warsaw limestone.

THE four following pages have already been printed and distributed in their present form, but are reprinted in this place, in order to bring together the supplementary matter relating to Vol. I of the Geological Report of Iowa to the present time.

Platyceras equilatera (n. s.).

SHELL of medium size, making little more than one volution : beak small, somewhat compressed and closely incurved; outer volution abruptly and almost equally expanded on each side; aperture broadly oval or subcircular, the outline undulated from incipient broad plications which commence near the margin.

SURFACE marked by undulating concentric lines of growth, which are often crowded, and subimbricating towards the margin of the shell.

This shell is subject to considerable variation in its different stages of growth. In the young state it is almost equally expanded on each side, and the beak incurved in the same plane : older specimens become faintly trilobed on the back; and finally this feature changes the form of the aperture, producing two deep sinuosities, one on each side, with an intermediate linguiform extension of the shell. In rare specimens the apex is larger and more rotund, being not quite so abruptly incurved.

Geological position and localities. In the Keokuk limestone : Keokuk and Warsaw.

Platyceras subrectum (n. s.).

SHELL conical or depressed conical : apex subcentral, terminal, straight and pointed; sides sloping gradually from the apex halfway to the base, below which the shell expands more rapidly : aperture widely expanded.

SURFACE marked by indistinct ridges below the middle, and by numerous closely arranged concentric striæ.

This species varies in the degree of expansion, some specimens being much more elevated in proportion to the width than others. All the specimens show incipient plications, and the older specimens show strong plications towards the aperture.

Geological position and localities. In the Keokuk limestone : Keokuk and Warsaw.

Platyceras fissurella (n. s.).

SHELL obliquely depressed conical, abruptly expanding below the apex on the anterior and lateral portions, and slightly concave posteriorly below the apex, and spreading at the margin : apex lateral, terminal, slightly advanced but not incurved. A small perforation penetrates the shell just anterior to the apex.

SURFACE somewhat rugose from closely crowded imbricating striæ, and the margin strongly lamellose.

This species is proportionally more expanded than *P. subrectum*, and the apex is lateral, while in entire specimens the small perforation just anterior to the beak is a peculiar character. The surface sometimes shows indistinct plications, but these are less defined than in *P. subrectum*.

Geological position and locality. In the Keokuk limestone : Nauvoo.

Platyceras biserialis (n. s.).

SHELL obliquely ovate : spire incurved, apparently sinistral, making little more than one volution; gradually expanding towards the aperture, which is deeply sinuate in front and roundish oval in form. The expanded portion of the volution is marked on each side by a row of small spines, about five or six in number on each side.

SURFACE marked by fine closely arranged undulating striæ.

The spire is apparently sinistral, though it has been but imperfectly seen; the form and direction of the last volution indicating this direction of the spire.

The species is quite distinct from a somewhat similar form in the Keokuk limestone, in the anterior sinus, and in the rows of spines marking the sides of the last volution.

Geological position and locality. In the Burlington limestone : Quincy, Illinois.

Platyceras reversum (n. s.).

SHELL ovate ventricose : spire small, reversed, closely incurved, making altogether about one and a half volutions; the first volution being very small, below which the shell is abruptly expanded and spreading towards the aperture, which is transverse, round oval, and somewhat straight on the columellar side.

SURFACE marked by concentric striæ and some obscure undulations.

This species presents some appearances indicating a columella, or a thickening of the aperture on that side; giving rise to a suspicion that there may be found characters to warrant a generic separation of this species, and possibly of the preceding one.

Geological position. Burlington limestone.

Platyceras? capulus (n. s.).

SHELL very broad, extremely depressed conical : apex subcentral; sides sloping almost uniformly in all directions, a little more abrupt posteriorly; aperture round oval, extremely expanded.

SURFACE marked by fine closely arranged concentric striæ; and when the shell is exfoliated, the surface shows strong radiating interrupted striæ upon every part of it.

This species is not uncommon in the Burlington limestone; but it is usually more or less exfoliated, and the concentric striæ are but partially or faintly preserved. The shell is thick, and in this respect unlike most of the species of the genus, and it is not improbable that it may ultimately be found a distinct type. Although rarely well preserved, it may be recognized by its general form; no other species in this limestone being similar.

Geological position and localities. In the Burlington limestone : Quincy (Illinois), and Burlington (Iowa).

Porcellia nodosa (n. s.).

SHELL convolute, discoid, concave at the sides. Volutions contiguous, about four, very gradually expanding, somewhat angular at the sides, the angles marked by a row of strong arching nodes : dorsal side regularly convex, with a strongly marked band which extends from the aperture backwards, and is shown in the cast for more than half the extent of the volution. Surface unknown.

The specimen is a cast in white decomposing chert, and the surface markings are unknown.

This is the first specimen of the genus which I have observed in American strata.

Geological position and locality. In the Burlington limestone, Illinois.

Nautilus biserialis (n. s.).

SHELL discoid, convolute, with the volutions in contact but not embracing. Volutions two or three, angular, somewhat rapidly enlarging; section subquadrangular; ventro-lateral edges angular, and often nodose; sides flattened, or moderately convex; dorso-lateral angles strongly nodose, with the nodes flattend and projecting laterally. Dorsum marked by a broad shallow groove, and bordered on each side by an obtuse ridge, which is often marked by a row of strong rounded nodes that may be opposite or alternate with those on the dorso-lateral angles. Aperture subquadrate, with a broad sinuosity on the dorsal margin.

SURFACE marked by fine elevated undulating striæ, which are bent backwards on the dorsum, corresponding to the sinuosity on the margin of the shell.

Septa numerous, very convex. Siphuncle ?

This species presents some variation in the development of the nodes upon the dorsal side, these being sometimes but partially developed or obsolete; and in the outer volution of old individuals the nodes become gradually subdued, until they are almost entirely obsolete.

The species bears some resemblance to *Nautilus* (*Ammonites*) *bellicosus* of MORTON, with which it is associated, but differs in the angular and nodose ventro-lateral edges, and in the double row of nodes and the broad shallow groove upon the dorsal side, as well as in other characteristics.

Geological position and locality. In the Coal measures of Iowa and Illinois.

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EXPLANATION OF PLATES.

PLATE 1.

Fig. 1 *a, b, c.* Pentremites conoideus.
Fig. 1 *d.* Pentremites conoideus; the summit enlarged, to show the small plates closing the ovarian orifices (from a figure by Dr. Shumard).
Fig. 2 *a.* Pentremites koninckiana; natural size.
Fig. 2 *b, c.* The same enlarged; lateral and summit views.
Fig. 3 *a, b.* Pentremites grosvenori.
Fig. 4 *a, b, c.* Dichocrinus simplex; basal, lateral and summit views.
Fig. 5. Dichocrinus dichotomus.
Fig. 6. Platycrinus pumilus.
Fig. 7. Platycrinus georgii.
Fig. 8. Cyathocrinus thomæ; the body and lower parts of the arms.
Fig. 9. Cyathocrinus thomæ; the body and part of the column.
Fig. 10. Scaphiocrinus divaricatus.
Fig. 11. Actinocrinus caroli.
Fig. 12 *a, b, c.* Anterior and posterior views of Actinocrinus calyculus.

PLATE 2.

Diagrams illustrating the structure of species, some of which have been published, in the Geological Report of Iowa and elsewhere, without these illustrations.

Fig. 1. Actinocrinus cœlatus : Iowa Geological Report, page 585.
Fig. 2. Actinocrinus corniculus : Iowa Geol. Report, p. 566.
Fig. 3. Actinocrinus brevis : Iowa Geol. Report, p. 567.
Fig. 4. Actinocrinus subrotundus (n. s.); a species of the type and form of *A. rotundus*, but smaller, and having an arm-formula of $\frac{2}{\frac{3\ 3}{4\ 4}}$, one ray being imperfect in the specimen.
Fig. 5. Actinocrinus ventricosus : Iowa Geol. Report, p. 595.
Fig. 6. Actinocrinus opusculus (n. s.). Body broadly calyculate; height little more than half the width, symmetrical, and rays equal with four arms each, the first plates of which project in a rim around the circumference, and have their articulating faces parallel with the longitudinal axis of the fossil.
Fig. 7. Actinocrinus tricornis : Iowa Geol. Report, p. 569.
Fig. 8. Actinocrinus pyriformis (Shumard): Geol. Report of Missouri, p. 192.
Fig. 9. Actinocrinus discoideus : Iowa Geol. Report, p. 594.
Fig. 10. Actinocrinus symmetricus : Iowa Geol. Report, p. 574. This species corresponds with *A. parvus* of Shumard (Geological Report of Missouri, p. 193), though his figure does not entirely correspond with our specimens. Dr. Shumard's specimen was found in the St. Louis limestone, while ours is from the Burlington limestone, the original being in Mr. Worthen's collection. It is a matter of interest to determine whether this species has so great a vertical range, particularly since this one is the only specimen of the Genus Actinocrinus known to me above the horizon of the Warsaw limestone.
Fig. 11. Poteriocrinus calyculus : Iowa Geol. Report, p. 553.

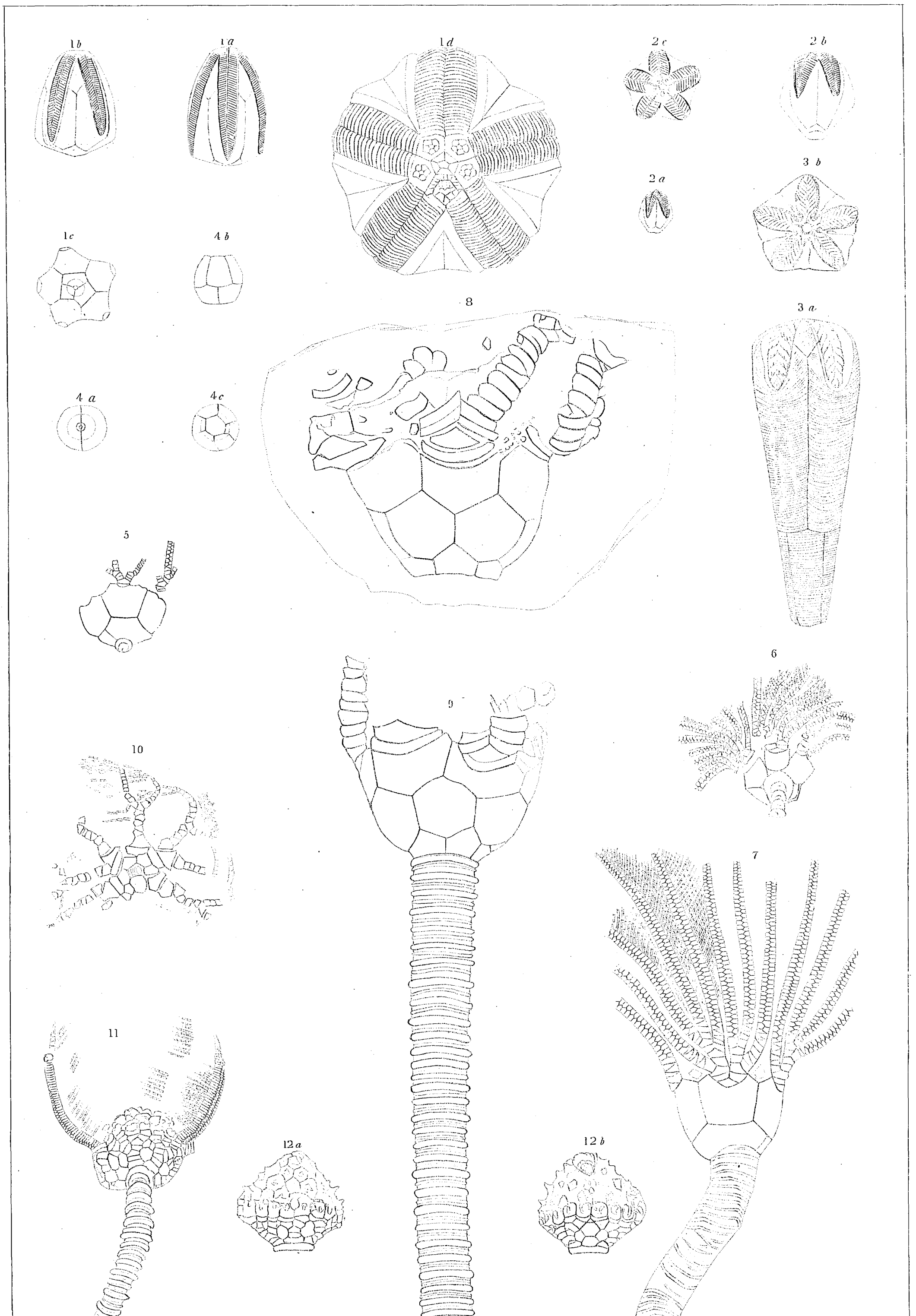
PLATE 3.

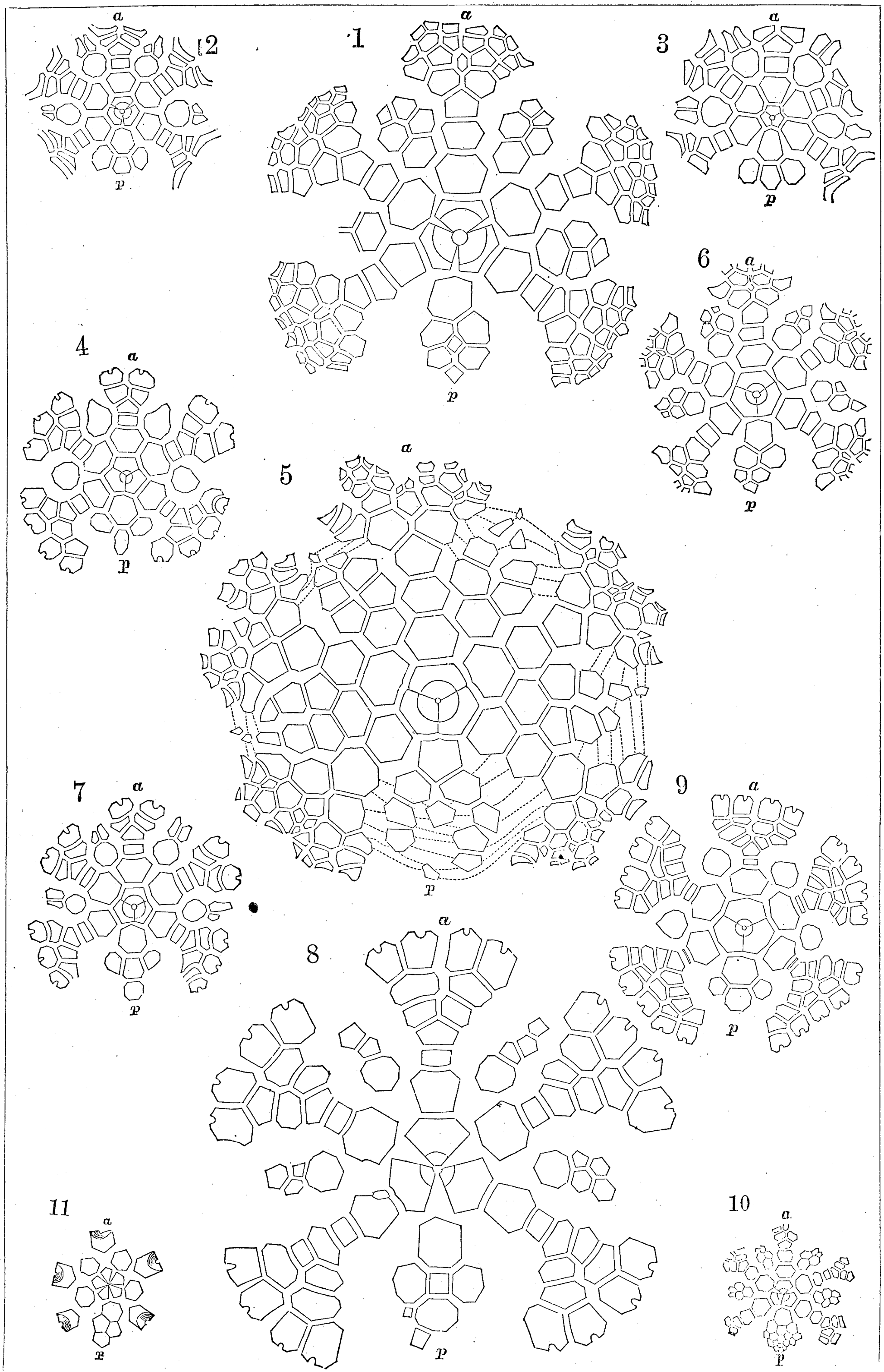
Fig. 1. Actinocrinus rotundus (Yandell and Shumard).
Fig. 2. Actinocrinus proboscidialis : Iowa Geological Report, page 584.
Fig. 3. Actinocrinus sculptus : Iowa Geol. Report, p. 582.
Fig. 4. Actinocrinus cornigerus : Iowa Geol. Report, p. 576.
Fig. 5. Agaricocrinus whitfieldi : Iowa Geol. Report, p. 621.
Fig. 6. Scaphiocrinus divaricatus.
Fig. 7. Forbesiocrinus wortheni : Iowa Geol. Rport, p. 632.
Fig. 8. Cyathocrinus rotundatus : Iowa Geol. Report, p. 555.

PL. I

Geological Survey of Iowa.

WARSAW LIMESTONE

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